Virginia Ecological Services

Strategic Plan 2017 – 2021

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U.S. Fish and Wildlife Service

Mission

Working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people.

Here are a few of the ways we try to meet our mission:

- Enforce Federal wildlife laws,
- Protect endangered species,
- Manage migratory birds,
- Restore nationally significant fisheries,
- Conserve and restore wildlife habitat such as wetlands,
- Help foreign governments with their international conservation efforts, and
- Distribute hundreds of millions of dollars, through our Wildlife Sport Fish and Restoration Program, in excise taxes on fishing and hunting equipment to State fish and wildlife agencies.

For more information on the U.S. Fish and Wildlife Service (Service) visit http://www.fws.gov/help/about_us.html.

Ecological Services

Through a series of laws created over the last century, Americans have declared that we need to collectively protect landscapes, fish, wildlife, and plants. Several agencies in the Federal government put our country's conservation laws into action, and the Service's Ecological Services Division helps lead the way.

We administer the Endangered Species Act (ESA), working with experts in the scientific community to identify species on the verge of extinction and undertake actions to recover those species. We work with our partners in Federal and state agencies, tribes, local governments, the business community, and private citizens, to help protect important habitat, increase species' populations, and reduce threats to their survival so that they can be removed from Federal protection.

To better understand these wild places, we map, monitor, and inventory our nation's wetlands. We provide guidance and expertise to protect wildlife for projects such as wind energy and large scale transportation developments meeting our society's growing energy and transportation needs.

Our environmental contaminant specialists review project plans, licenses, and proposed laws and regulations, to avoid or minimize harmful effects on wildlife and habitats. In cases of significant releases of hazardous waste, they work in the field to pinpoint sources of pollution and investigate effects, using this data to secure compensation for lost or damaged wildlife and habitat.

With offices in all 50 states, Ecological Services is working with you to meet the challenge of conserving the nature of America. When we protect species and habitats, we conserve the natural resources on which we all depend. Wild things and wild places are part of our shared history. They are part of the natural foundation of the lands we call home.

To provide a more detailed understanding of programs within Ecological Services, we provide program-specific information below.

Conservation Planning Assistance (CPA) Program

The Service works directly with other Federal agencies and programs, as well as the American public, on infrastructure development projects to protect the environment and preserve our nation's biological resources. Protection of these resources is accomplished through early coordination between the Service and other Federal agencies on project planning and design to minimize potential environmental impacts and provide for successful mitigation for unavoidable impacts. The Service uses its authorities under the Clean Water Act, Federal Power Act, Fish and Wildlife Coordination Act, National Environmental Protection Act, Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, and other laws to protect fish and wildlife resources. For more information about the CPA Program in Virginia, visit: http://www.fws.gov/northeast/virginiafield/endangered/about.html.

Endangered Species (ES) Program

The Service and the National Marine Fisheries Service (NMFS) are the principal Federal agencies responsible for administering the ESA. We recover and conserve our Nation's imperiled species by fostering partnerships, employing scientific excellence, and developing a workforce of conservation leaders. As we work in partnership with others, our 2 major goals are: (1) protect and recover endangered and threatened species, and (2) conserve candidate species and at-risk species so that listing under the ESA is not necessary. These goals are achieved through the following activities: candidate and at-risk species conservation, consultation with other Federal agencies, administration of grants for states and territories, applicant assistance during the Habitat Conservation Planning process, international activities, listing species, designating critical habitat, recovery plan development and implementation, and working with American Indian Tribes. For more information about the ES Program in Virginia, visit: http://www.fws.gov/northeast/virginiafield/endangered/about.html.

Environmental Contaminants (EC) Program

The Service's EC biologists are trained in spill response and coordinate with state and other Federal agencies in spill preparedness and response to oil and hazardous chemical spills so harm to fish and wildlife can be minimized. The Service works with state and other Federal agencies to restore natural resources destroyed or degraded by oil spills or hazardous waste through the Natural Resource Damage Assessment and Restoration (NRDAR) program. We work with state and other Federal natural resource agencies to plan and implement restoration activities to compensate for injury to fish, wildlife, and their habitats from the released contaminant. For more information about the EC Program in Virginia, visit: http://www.fws.gov/northeast/virginiafield/environmentalcontaminants/index.html.

Partners for Fish and Wildlife (PFW) Program

The Service's PFW Program provides technical and financial assistance to private landowners and Tribes to plan, implement, and monitor habitat projects. We are guided by national priorities and priority ranking factors including: improving habitat for Federal trust species; promoting partnerships; encouraging public understanding and participation; working with U.S. Department of Agriculture (USDA) to implement conservation programs; complementing activities on National Wildlife Refuge

(NWR) System lands; addressing species and habitat priorities identified through Service and state planning; establishing natural buffers adjacent to state and Federal lands; reducing habitat fragmentation; and establishing self-sustaining ecosystems. PFW Program staff help landowners find other sources of funding and assist them through the permitting process, as necessary. We can assist with projects in all habitat types that conserve or restore native vegetation, hydrology, and soils associated with imperiled ecosystems or otherwise provide an important habitat requisite for a rare, declining, or protected species. For more information regarding the PFW Program in Virginia, visit: http://www.fws.gov/northeast/virginiafield/partners/about.html.

Virginia Ecological Services – Strategic Plan Development

Virginia Ecological Services (VAES) includes 2 geographically separate locations; the Virginia Field Office (VAFO) located in Gloucester and the Southwestern Virginia Field Office (SVFO) located in Abingdon.

Purpose

The purpose of developing and implementing a Strategic Plan for VAES is to determine resource priorities statewide and a strategic approach to addressing these priorities in our daily actions, resulting in a more focused effort on specific Service priorities that will produce the largest conservation benefit.

Priority Identification

In October 2015, VAES staff met and discussed how best to develop a new strategic plan or update the 2010-2014 Virginia Ecological Services Strategic Plan (Service 2010). We initially agreed to update the existing plan, using same approach as in the 2010-2014 Plan. Specifically, we agreed to use new/updated data, add/remove priority areas, and update other information as necessary. To accomplish this, all VAES staff reviewed the 2010-2014 Plan, providing recommendations/comments (e.g., delete a priority area, add a new priority area, add/delete data and species).

In January 2016, staff convened and reviewed/discussed the recommendations/comments provided on the 2010-2014 Plan. The following were agreed to: (1) throughout the document remove references to specific projects as these quickly become outdated, and remove references to efforts completed or no longer being considered and instead provide more general descriptions of next steps/ongoing efforts; (2) keep premise of any information about each focal area, but eliminate the term “focal area” as it causes confusion with the term “priority area”; (3) address how we work with NWRs when they are not delineated as priority areas; (4) remove appendices of out-year conservation actions since we develop and maintain these as our Annual Work Plan; (5) consider and incorporate data/tools from Landscape Conservation Cooperatives and Virginia’s State Wildlife Action Plan (Virginia Department of Game and Inland Fisheries [VDGIF] 2015); (6) update migratory bird/fisheries/proposed, candidate, and listed species data using best available data and reference data sources instead of providing species lists; (7) remove Rappahannock River NWR as a priority area as it is no longer a specific focus of activity; (8) maintain threats assessment for each priority area completed during development of 2010-2014 Plan and provide minor updates as most threats have not changed; and (9) maintain and update Inter-Program Coordination section because it provides valuable information on how we coordinate to ensure the best possible conservation outcome.

In January and February 2016, staff continued to edit and update the document as outlined above. A subset of the staff met to discuss how to incorporate the best available data on migratory birds and priority fisheries. We agreed that priority bird areas, which includes climate change projections, will be delineated and text will be provided indicating how those species will be addressed by each Program. Similar action will be taken for priority fisheries.

In March 2016, staff met and agreed to delete Great Dismal Swamp NWR as a priority area because it is no longer a specific focus of activity. Additionally, we discussed how to best address migratory birds by using Audubon's Important Bird Areas. Specific to priority fisheries, we agreed that many of our priority areas are identified by watershed and we rely on NMFS, VDGIF, and the Service's Appalachian Partnership Coordinator to assess fisheries impacts/conservation needs and make us aware of any concerns/issues we need to address. As a result, we will not be preparing specific information on priority fisheries. The supporting lists of listed/proposed/candidate species were deleted; updated and improved information can be obtained by accessing the Service's Information Planning and Conservation system at https://ecos.fws.gov/ipac/.

In May 2016, staff met and agreed to combine the Blackwater River Watershed and Nottoway River Watershed priority areas. Because the Blackwater River Watershed priority area focus has shifted solely to red-cockaded woodpecker (*Picoides borealis*) recovery, it initially made sense to develop a red-cockaded woodpecker priority area. However, after further discussion it was clear that our focus is not recovery for this species throughout its entire range in Virginia. As a result, we combined the 2 areas that contain red-cockaded woodpecker recovery as all or part of their focus. We again discussed how to address migratory birds and agreed that additional information was needed on how we plan to proceed. We discussed the utility of maps of individual priority areas and are no longer going to include these maps because they are accessible online.

In June and July 2016, staff reviewed and edited the entire document for accuracy and clarity. In August 2016, the document was revised to incorporate staff edits.

In September 2016, staff met to review the entire document and discuss how to finalize. Minor changes were made to the table below; specifically additional clarification was added to the priority column. We agreed to delete the appendix providing only the high level threats and instead highlight the high level threats in Appendix 2; this minimized the document length while continuing to put a focus on the high level threats. Prior to finalizing the document, recently hired staff were provided the opportunity to review and comment on the document.

From November 2016 through February 2017, final reviews and edits were made and addressed.

The result is the following priority areas.

Priority Area Name	EC Program Focus	ES/CPA Program Focus	PFW Program Focus	Focus of Priority Area
Blackwater and Nottoway Rivers Watershed	X	X	X	Atlantic Slope mussel conservation/red-cockaded woodpecker recovery/global biodiversity hotspot
Clinch and Powell Rivers Watershed	X	X	X	Recovery for multiple listed species/national biodiversity hotspot
Eastern Shore		X		Recovery for multiple listed species
Holston River Watershed	X	X	X	Recovery for multiple listed species/national biodiversity hotspot
James Spinymussel	X	X	X	James spinymussel (*Pleurobema collina*) recovery
Madison Cave Isopod	X	X		Madison Cave isopod (*Antrolana lira*) recovery
Northeastern Beach Tiger Beetle		X		Northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*) recovery
Roanoke Logperch	X	X	X	Roanoke logperch (*Percina rex*) recovery

Note – In some priority areas all Ecological Services programs will work to address threats together or with our partners. In other priority areas 1 or more Ecological Services programs will be addressing these threats with our partners.

Blackwater and Nottoway Rivers Watershed Priority Area

The watershed is an important headwater to the Albemarle and Pamlico Sounds, is uniquely pristine, and is a recognized North American Coastal Plain global biodiversity hotspot. This area historically supported longleaf pine dominated ecosystems and their unique community of species, including the red-cockaded woodpecker. We will pursue funding to restore longleaf pine habitat for the red-cockaded woodpecker and priority migratory birds in coordination with partners, such as the Virginia Longleaf Pine Cooperators local implementation team (Regional Working Group for America's Longleaf 2009). We will also support projects that restore or enhance habitat and water quality to promote conservation of

Atlantic slope mussels (e.g., dwarf wedgemussel, Atlantic pigtoe). The watershed hosts multiple fisheries species of conservation concern and priority migratory bird species (see Service Trust Resources section). Roanoke logperch (see Roanoke Logperch Priority Area information below) also occurs in the Nottoway River drainage and we will work with our partners to engage in outreach and support survey efforts for Roanoke logperch as well as projects that enhance habitat and water quality such as barrier removal (restore connectivity), implementing agricultural best management practices (BMPs) (e.g., excluding livestock from streams), and stream and riparian restoration.

Clinch and Powell Rivers Watershed Priority Area

Draining parts of 2 states, the Clinch and Powell Rivers watershed above Norris Lake harbors more than 35 federally listed threatened and endangered species, the majority of which are freshwater fishes and mussels, and designated critical habitat for more than 5 species. The watershed also hosts multiple fisheries species of conservation concern and priority migratory bird species (see Service Trust Resources section). The area is globally significant and was included in an area designated in 1988 by the United Nations Educational, Scientific and Cultural Organization as the Southern Appalachian Man and the Biosphere Reserve. Our goal is to protect and recover these species and maintain and restore the habitats upon which they depend. In accordance with the Imperiled Aquatic Species Conservation Strategy for the Upper Tennessee River Basin (Service 2014), our next steps towards this goal are to propagate and release listed fish and mussel species; ensure water quality protections are in place through the review of federally funded and permitted activities; and evaluate exposure to and toxicological effects of contaminants in water and sediment. We will partner with conservation organizations, municipalities, and landowners to implement stream restoration and riparian buffer projects in the watershed.

Indian Creek Watershed – The federally listed purple bean (*Villosa perpurpurea*), rough rabbitsfoot (*Quadrula cylindrica strigillata*), and tan riffleshell (*Epioblasma florentina walkeri*) are found in Indian Creek. After a tanker truck spill in 1998 killed populations of these species in the mainstem Clinch River and a catastrophic sedimentation event during construction of a gas pipeline in 2006 affected the Indian Creek populations, Indian Creek became the focus of restoration efforts. This watershed discharges to the upper reaches of the Clinch River and affects mainstem water quality. We will evaluate exposure to and toxicological effects of contaminants in water and sediment and pursue available partnership opportunities for riparian protection, streambank stabilization, research, and other recovery activities to benefit listed aquatic species.

Copper Creek Watershed – In Copper Creek there are more than 10 federally listed mussels and fishes, and critical habitat has been designated for some of these species. This watershed discharges to the Clinch River and affects mainstem water quality. Many listed species propagation and release efforts have taken place, such as those for the federally listed threatened yellowfin madtom (*Noturus flavipinnis*). Although threats from agriculture are high, many partners are working in the drainage to address the problems. The PFW Program has longstanding involvement in the drainage and has funded several projects, including stream restoration, riparian buffers, and fish barrier removal. We will restore fish passage, protect and restore streambanks, and conduct outreach activities to inform the community about other impacts to federally listed species and aquatic communities.

Powell River Watershed at River Mile 116.5 to River Mile 175.0 – There are more than 20 federally listed threatened and endangered aquatic species in this portion of the Powell River watershed, and species demonstrate a high degree of endemism. The watershed contains significant karst resources, including

the only known populations of the federally listed endangered Lee County cave isopod (*Lirceus usdagalun*). Threats from coal mining and natural gas drilling, which are economically and politically difficult to address, may render listed aquatic species vulnerable to extirpation and extinction. We will continue research and recovery efforts by reviewing projects and permits in accordance with the ESA and by participating in technical advisory teams. We will assist conservation partners in enhancing implementation of BMPs related to livestock operations via various cost share programs and in land protection to expand the Virginia Department of Conservation and Recreation, Division of Natural Heritage's (VDCR-DNH) The Cedars Natural Area Preserve.

Eastern Shore Priority Area

There are at least 10 federally listed threatened and endangered species, the majority of which rely on coastal environments, on this Virginia peninsula and its many offshore islands. The area also hosts multiple fisheries species of conservation concern and important migratory bird stopover habitat. It supports 4 NWRs and TNC's Virginia Coast Reserve, has been designated a United Nations Biosphere Reserve (http://www.unesco.org/mabdb/br/brdir/directory/biores.asp?mode=all&code=USA+31), and is included in the North American Coastal Plain global biodiversity hotspot (http://www.cepf.net/news/top_stories/Pages/Announcing-the-Worlds-36th-Biodiversity-Hotspot.aspx#.WMGTSm_ytxA). Our goal is to restore/protect upland, wetland, and coastal habitat for listed species, priority migratory birds, and fisheries species of conservation concern on state, Federal, and private lands.

Holston River Watershed Priority Area

The Virginia portion of this watershed has more than 30 federally listed threatened and endangered species, the majority of which are freshwater fishes and mussels, and designated critical habitat for some of the species. The watershed also hosts several fisheries species of conservation concern and more than 20 priority migratory bird species (see Service Trust Resources section). This watershed is an important headwater area of the Tennessee River system and is a globally significant area of biodiversity. Our goal is to protect and recover these imperiled aquatic species and maintain and restore the habitats upon which they depend. In accordance with the Imperiled Aquatic Species Conservation Strategy for the Upper Tennessee River Basin (Service 2014), our next steps towards this goal are to propagate and release listed fish and mussel species. We are focusing on reintroducing the yellowfin madtom in the North Fork Holston River reach designated for establishment of a non-essential experimental population; ensuring water quality protections are in place through the review of federally funded and permitted activities, and continuing case work for the Saltville NRDAR. We will continue efforts to collaborate with Service's Fish and Aquatic Conservation Division to remove fish passage barriers in the Middle Fork Holston watershed, and partner with local conservation organizations to implement streambank stabilization and riparian buffers in the Holston River watershed.

James Spinymussel Priority Area

This federally listed endangered species extant range is North Carolina, Virginia, and West Virginia; the majority of which occurs in Virginia. Our goal is to further the recovery of this species through protection/restoration of habitat and improvement to water quality. A number of non-governmental organizations, as well as state and local agencies, are interested in recovery of the species and enhancing water quality and habitat. We will support our partners to ensure completion of ongoing life history studies and focus on riparian and stream restoration, barrier removal (restore connectivity), livestock exclusion from streams, livestock watering and shelters, trapping of mammalian predators, and

other projects that will improve or protect James spinymussel populations and its habitat. We will support modeling efforts to refine potential habitat, work with our partners to engage in outreach, and support survey, propagation, and augmentation efforts for this species.

Madison Cave Isopod Priority Area

This federally listed threatened species is a Virginia and West Virginia endemic. Our goal is to further recovery of this species through development of BMPs for landowners/project proponents and implementation by working with localities. To better understand historic connectivity between locations where this species occurs, we will continue to support genetic studies of isopods captured at different locations throughout the species range. We are working with partners to better characterize and understand the physiochemical characteristics of the groundwater habitat, determine variability in site occupancy and abundance, and collect genetic material for future analysis.

Northeastern Beach Tiger Beetle Priority Area

This federally listed threatened species range encompasses the coast of the northeastern U.S., with the majority of the species extant range occurring along the beaches of the Chesapeake Bay in Virginia. Our goal is to develop and implement a multi-faceted, multi-partner, long-term recovery strategy for the species. We will work with project proponents to define future project areas and proactively target areas of current or potential tiger beetle habitat for restoration or habitat improvement. We will foster improved shoreline management efforts on a scale to benefit property residents and the tiger beetle and its habitat. We will focus our work based on project requests and areas that provide an opportunity for proactive improvement or restoration of connectivity between populations.

Roanoke Logperch Priority Area

This federally listed endangered species extant range is North Carolina and Virginia; the majority of which occurs in Virginia. Our goal is to recover the species by working with our partners to protect/restore habitat, evaluate reintroduction/augmentation, and accomplish other recovery actions. We will work with our partners to engage in outreach and support survey efforts, as well as projects that enhance habitat and water quality such as barrier removal (restore connectivity), implement agricultural BMPs (e.g., excluding livestock from streams), and restore stream and riparian habitats. We will support life history studies that inform recovery efforts and modeling projects that refine potential habitat for this species.

Map Development

Since the 2010-2014 Plan, additional species occurrences have been documented and our understanding of the probability of species occurrence has improved. The 2017 map of the priority areas (Appendix 1) is available at https://www.fws.gov/northeast/virginiafield/. Shapefiles of the priority areas are available for download via ArcGIS online (see data access link for each priority area description) or can be added to an ArcMap using the add data via ArcGIS Online option.

The priority areas identified geographically/by watershed were mapped based on 8-digit hydrologic unit code (HUC). Eight-digit HUCs (average size 945,451 acres) were chosen because 10- (average size 86,918 acres) and 12- (average size 21,455 acres) digit HUCs were smaller and would have created fragmented priority areas.

- Blackwater and Nottoway Rivers Watershed Priority Area – boundaries defined by the extent of HUCs 03010202 and 03010201 (Data Access).
- Clinch and Powell Rivers Watershed Priority Area – boundaries defined by the extent of HUCs 06010206 and 06010205; includes the upper Clinch and Powell River HUCs (Data Access).
- Eastern Shore Priority Area – boundaries defined by the extent of HUCs 02080109 and 02080110; includes the Eastern and Western Lower Delmarva HUCs (Data Access).
- Holston River Watershed Priority Area – boundaries defined by the extent of HUCs 06010101 and 06010102; includes the North Fork, South Fork, and Middle Fork Holston River HUCs (Data Access).

The priority areas identified by species were mapped as follows:

- James Spinymussel Priority Area – boundaries defined by the intersection of the 12-digit HUCs with the potential habitat model developed by VDCR-DNH and coordinated with VDGIF (Data Access).
- Madison Cave Isopod Priority Area – boundaries defined by areas with a high/medium probability of species occurrence based upon a distribution model created by VDCR-DNH. As a karst aquifer species, it is difficult or even impossible to survey all locations; therefore, mapping known locations would greatly underestimate the range of the species (Data Access).
- Northeastern Beach Tiger Beetle Priority Area – boundaries based on surveys, observations, and preliminary modeling; delineated areas are a 75 meter buffer surrounding shoreline areas known to have habitat that supports or may support the beetle. The boundaries also include adjacent shorelines where most shoreline stabilization projects, if undertaken, may result in a negative impact to the adjacent areas used by the beetle (Data Access).
- Roanoke Logperch Priority Area – boundaries defined by the intersection of the 8-digit HUCs and the counties where the species is known to occur; VDGIF and VDCR-DNH databases were used to delineate known species occurrences (Data Access).

Service Trust Resources

Within each priority area, multiple Service trust resources (priority migratory birds, fisheries species of conservation concern [fishes/mussels], listed species [federally listed and proposed species, federally designated critical habitat, Federal candidate species, at-risk species, species of concern,]) are frequently present. We are identifying these trust resources as described below.

Priority Migratory Bird Areas

Priority migratory bird areas includes all of Audubon's Important Bird Areas with bird species that received a highest or high priority ranking as determined by the Service's list of Birds of Conservation Concern (BCC) (Service 2008) (https://www.fws.gov/migratorybirds/pdf/grants/BirdsofConservationConcern2008.pdf). The BCC 2008 encompasses 3 distinct geographic scales—North American Bird Conservation Initiative Bird Conservation Regions, Service Regions, and National—and is primarily derived from assessment scores from 3 major bird conservation plans: the Partners in Flight North American Landbird Conservation Plan, the United States Shorebird Conservation Plan, and the North American Waterbird Conservation Plan. Audubon's Important Bird Areas Program is an effort to identify and conserve areas that are vital to birds and other biological diversity (http://web4.audubon.org/bird/iba/). We will use this information when providing conservation recommendations for projects with potential impacts to birds.

A map of the priority migratory bird areas is available via ArcGIS Online. To determine the species within each of the identified areas, click within the area on the map. A pop-up window will display information about the area including the total number of priority species. For a list of specific species for that area, click "Show Related Records" from the pop-up window.

Fisheries Species of Conservation Concern

We will rely on the Service's Virginia Fish and Wildlife Conservation Office, the Service's Appalachian Partnership Coordinator, NMFS, and VDGIF to assess impacts/conservation needs, make us aware of any concerns/issues we need to address, and provide us with appropriate conservation recommendations for fisheries species of conservation concern.

Listed Species

Listed species includes known or likely federally listed endangered and threated species, species proposed for Federal listing as endangered or threatened, Federal candidate species, at-risk species, species of concern, and federally designated critical habitat based on information from:

- Service's Information Planning and Conservation system (https://ecos.fws.gov/ipac/).
- VDGIF VaFWIS database (http://vafwis.org/fwis/).
- VDCR-DNH database (http://www.dcr.virginia.gov/natural_heritage/dbsearchtool.shtml).

Threats Assessment Development

After priority areas were determined in the 2010-2014 Plan, we completed a threats assessment for each priority area. The purpose of the threats assessments was to (1) identify, characterize, and prioritize threats to trust resource species (priority migratory birds, fisheries species of conservation concern, listed species) in the priority areas identified geographically/by watershed/by NWR and (2) identify, characterize, and prioritize threats to a specific species (James spinymussel, Madison Cave isopod, Northeastern beach tiger beetle, Roanoke logperch) in the priority areas identified by species. The assessments identify conservation actions intended to remove or reduce threats to Service trust resources within each priority area.

For each priority area threats assessment, the following was determined based on group discussion resulting from staff experience and review of relevant documents (e.g., TNC 2009): threat (i.e., type of threat), stressor (i.e., agent causing the threat), cause of the threat, level of threat, trust resources affected, what Ecological Services can do to address the threat, who can help Ecological Services address the threat. We assessed each threat as high, medium, or low. The assessment of threat level included the impact occurring now and the likelihood of threat in near-term future.

All threats related to climate change were assessed as high. We were, and may still be, uncertain of the appropriate assessment of threat related to climate change in some instances and additional data may change a specific assessment of threat over time.

Spills (oil, chemical, etc.), were assessed as high for the level of threat. Virginia has thousands of miles of ocean coastline and inland river systems as well as a multitude of diverse wetland habitats that support an abundance of trust resources. The potential for environmental injury from chemical and oil spills in these sensitive habitats is significant. On average, the EC Program annually reviews over 500 National

Response Center spill reports for Virginia. An analysis of these reports indicates that transmission of oil and chemicals via navigable waterways, railroads, pipelines, and/or tanker traffic on roads adjacent to waterways, pose serious and on-going threats to trust resources.

The threats assessments from the 2010-2014 Plan have been retained and updated to reflect completed actions and new information (Appendix 2). As with the 2010-2014 Plan, we will continue to focus on those threats that received an assessment of high. Threats ranked as high are highlighted in Appendix 2 for ease of reference.

Strategic Habitat Conservation and Conservation Actions

Strategic Habitat Conservation (SHC) is how the Service thinks about and implements conservation in a strategic, accountable, and adaptive manner. It starts by working at larger spatial and temporal scales, across programs and with our partners and stakeholders, in a more focused way that links our actions to outcomes, with learning as an explicit objective of our conservation actions. SHC is a science-based framework for making management decisions about where and how to deliver conservation efficiently to achieve specific biological outcomes. SHC is a way of thinking and of doing business that requires us to set specific biological goals, allows us to make strategic decisions about our work, and encourages us to constantly reassess and improve our actions.

Each year we develop an Annual Work Plan that details conservation actions planned for the upcoming fiscal year. The Annual Work Plan includes actions to address high level threats in priority areas through biological planning, conservation design, conservation delivery, monitoring, and research. Additionally, some key activities that will take place outside of priority areas are captured in the Annual Work Plan. Accomplishments under our Strategic Plan will continue to be reported utilizing the Service's Northeast Region Ecological Services Priority Planning database that was created for this purpose.

Virginia Ecological Services – Strategic Plan

Approach

VAES will focus our personnel and financial resources in the priority areas (see map in Appendix 1) to achieve a significant conservation benefit. We will concentrate on removing and reducing high level threats identified in Appendix 2 and through other sources of information by implementing actions contemplated in those threats assessments both within Ecological Services programs and with the assistance of our internal/external partners. At times we will be working on species/issues outside the priority areas and in those instances we will attempt to resolve the matter expeditiously to return our focus to our priorities.

Goals

- Focus staff and monetary resources on addressing high level threats identified in each priority area (Appendix 2 and other reliable sources).
- Make known to our internal/external partners where priority areas are located and what the high level threats are and how we plan to address them.
- Make our internal/external partners aware of outstanding needs they can help us to meet.

- Outside of priority areas, in most instances, spend minimal staff and monetary resources addressing conservation issues to ensure our focus remains on addressing high level threats in priority areas.

Inter-Division Coordination

To achieve the mission of the Service, we will request assistance from and provide assistance to other Service divisions (Fish and Aquatic Conservation, Migratory Birds, NWR System, Office of Law Enforcement, Wildlife and Sport Fish Restoration). To be effective in our efforts to address our highest priorities, we recognize a need to overcome staffing, workload, and geographic limitations. To accomplish this, VAES staff will work cooperatively with other Service divisions to provide assistance and support on actions involving high level threats within priority areas. Outside priority areas, we will attempt to resolve the matter expeditiously to return our focus to our priorities.

Inter-Program Coordination

Within Ecological Services, to be effective in our efforts to address our highest priories, we recognize a need to overcome staffing, workload, and geographic limitations. To accomplish this, staff will work cooperatively across program boundaries to provide assistance and support on actions involving high level threats within priority areas, as described below.

ES Program/CPA Program

SVFO ES Program and VAFO ES and CPA Programs will assess the status of listed and petitioned species, conduct candidate conservation, consult with other Federal agencies, coordinate on grants for states, assist applicants during the Habitat Conservation Planning process, list species, designate critical habitat, and develop and implement recovery actions/plans. The online project review process (http://www.fws.gov/northeast/virginiafield/endangered/projectreviews.html) will be used to address requests for species lists and technical assistance. The response received from applicants through the online process will be evaluated based on the project's relation to priority areas and high level threats. Large-scale, regional, or programmatic activities outside of priority areas may receive consideration and attention due to policy implications, peripheral resource-related effects, and similar links to priorities. Consultation requests within priority areas that involve high level threats will receive the greatest level of scrutiny and Service involvement to maximally incorporate appropriate mitigation measures. Consultation requests within priority areas that involve medium level threats will receive a moderate level of review and we will attempt to incorporate simple avoidance and minimization measures or incorporate activities that will also address related high level threats. Requests for consultation on projects located outside priority areas or those located within priority areas that involve low level threats will receive effort and attention that meets statutory requirements. The CPA Program will engage in projects/issues/activities that relate to priority areas and high level threats.

For all other ESA activities, the SVFO ES Program and VAFO ES Program will identify, foster, and carry out those activities that will ameliorate high level threats in priority areas in which the Program has a role. These activities will be identified, reviewed, coordinated, and funded, as appropriate, in collaboration with the EC and PFW Programs.

EC Program

VAFO EC Program will assess and address potential threats to species and habitat by: participating in Triennial Review and individual amendments of Virginia's Water Quality Standards; continuing to review/provide comments on General Virginia Pollution Discharge Elimination System Permit renewals; participating in Virginia Department of Environmental Quality (VDEQ) regulatory changes that affect Clean Water Act 401 and 402 program areas; providing scientific literature to VDEQ to support criteria and standards that protect sensitive aquatic species; seeking funding for new research to provide information on species sensitivity to various pollutants of concern; participating in total maximum daily load (TMDL) work groups to address nutrients, sediments, other contaminants, and mining-related contaminant threats in priority areas; focusing spill preparation and response efforts in all priority areas; focusing NRDAR Program actions in priority areas when possible; considering priority areas and species when developing NRDAR-related restoration projects; providing technical assistance to the Environmental Protection Agency (EPA) through the Biological Technical Assistance Group on hazardous waste sites as prioritized by EPA; providing technical assistance to NWRs through the Contaminant Assessment Process; supporting ES Program efforts, as appropriate, to review permits, practices, and threats to trust resources.

PFW Program

VAES PFW Program will conduct habitat restoration for conservation and recovery of listed species on private lands in priority areas throughout Virginia. This will be accomplished through collaboration with the Appalachian Partnership Coordination Office, EC Program, ES Programs (SVFO and VAFO), Natural Resource Conservation Service (NRCS), TNC, VDCR-DNH, Virginia Department of Forestry (VDOF), VDGIF, and private landowners to obtain and provide funds, determine project locations, prioritize projects, and conduct outreach efforts. Through this collaboration, existing habitat can be restored and expanded, habitat fragmentation can be reduced, and habitat corridors linked. GIS planning and mapping assistance is provided to the EC Program, CPA Program, and ES Programs (SVFO and VAFO).

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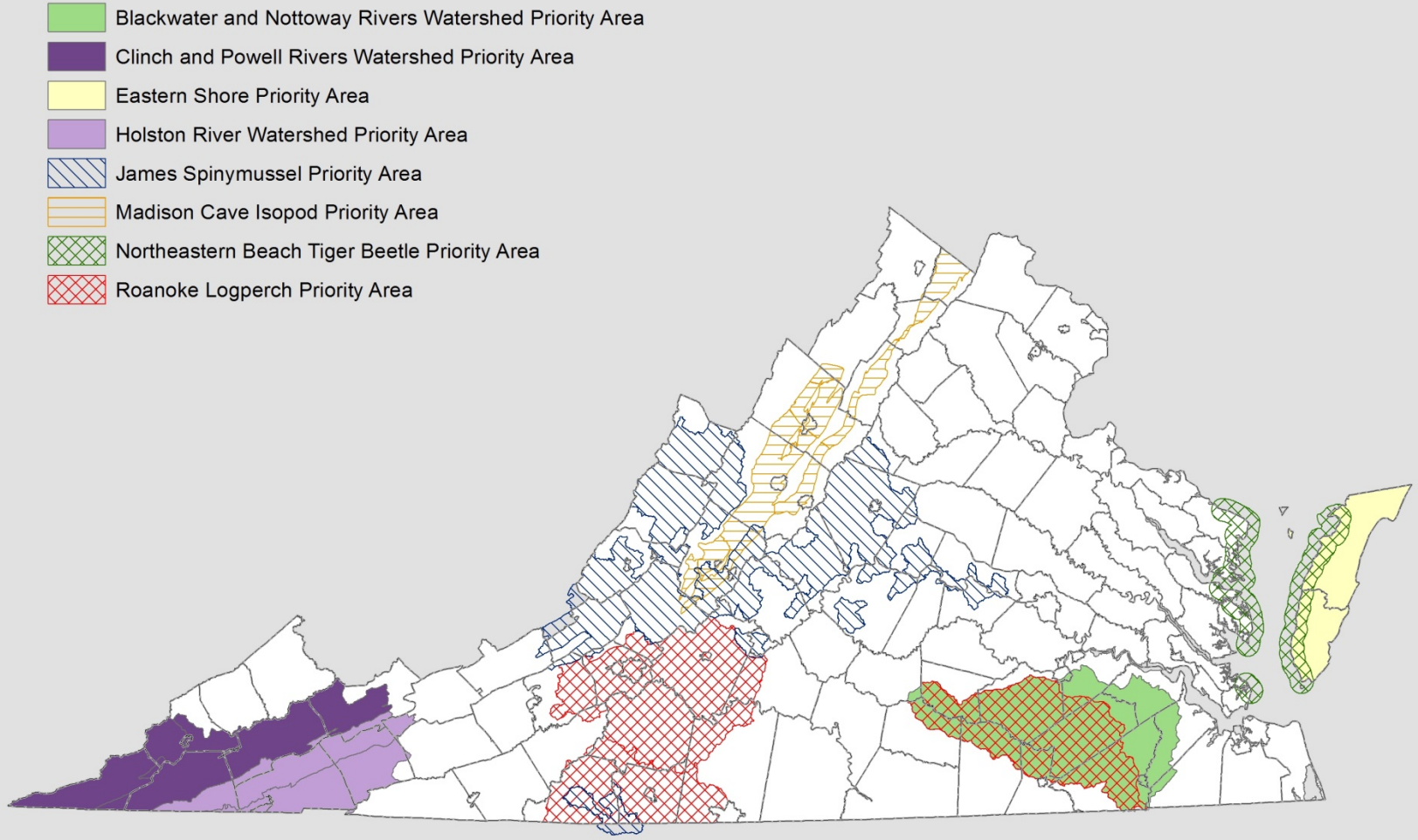
Appendix 1 – Priority Areas Map

Virginia Ecological Services Priority Areas
3/15/2017



Virginia Ecological Services staff continue to have state-wide programmatic responsibility and will focus on identified priority areas

Appendix 2 – Threats Assessments for Priority Areas

BLACKWATER AND NOTTOWAY RIVERS PRIORITY AREA WATERSHED THREATS ASSESSMENT						
Threat	**Stressor**	**Cause**	**Assessment of Threat on Species[1] (high, medium, low)**	**Trust Resources Affected[2]**	**What Ecological Services Can Do[3]**	**Who Can Address Problem[4]**
habitat loss/ degradation/ fragmentation	instream flow/hydrologic alterations	climate change	H	all species	establish habitat corridors	Coastal Program, NAWCA, PFW, CPA, NGOs, NOAA, ES, VDCR-DNH, VDGIF, VDOF, landowners
habitat loss/ degradation/ fragmentation	contaminants	mercury	H	all species	restore wetlands	Coastal Program, NAWCA, PFW, NGOs, VDCR-DNH, VDGIF, landowners
habitat loss/ degradation/ fragmentation	contaminants	spills	H	all species	spill prevention/planning, respond to spills as needed; work with others on training for spill response; work with DoD; follow through with NRDAR where appropriate	EC, CPA, ES, NWRS, USCG, VDEQ, NOAA, EPA, Conservation Management Institute, DoD
habitat loss/ degradation/ fragmentation	shifts in native communities/species composition, including non-natives	climate change	H	all species	restore habitat/protect lands; establish/protect habitat corridors; prioritize conservation actions/funding decisions to consider climate change; control invasives	NOAA, NAWCA, All, NRCS, NGOs, VDCR-DNH, VDGIF, VDOF, landowners
habitat loss/ degradation/ fragmentation	human migration/ relocation	climate change	H	all species	restore habitat/protect lands; education/outreach	NOAA, NAWCA, PFW, Coastal Program, NRCS, NGOs, VDCR-DNH, VDGIF, VDOF, landowners
habitat loss/ degradation/ fragmentation	increased drought/ increased rainfall	climate change	H	all species	work with VDEQ on water supply planning to include trust resource needs; restore habitat/protect lands	VDEQ, PFW, Coastal Program, NRCS, NGOs, VDCR-DNH, VDGIF, VDOF, landowners
habitat loss/ degradation/ fragmentation	sea level rise	climate change	H	all species	restore habitat/protect lands; establish/protect habitat corridors; prioritize conservation actions/ funding decisions to consider climate change; planning; education/outreach	NOAA, NAWCA, PFW, Coastal Program, NRCS, NGOs, VDCR-DNH, VDGIF, VDOF, landowners
habitat loss/ degradation/ fragmentation	change in instream temps	climate change	H	all species	restore habitat/protect lands; establish/protect habitat corridors	NOAA, NAWCA, PFW, Coastal Program, NRCS, NGOs, VDCR-DNH, VDGIF, VDOF, landowners
habitat loss/ degradation/ fragmentation	increased storm events	climate change	H	all species	restore habitat/protect lands; establish/protect habitat corridors; prioritize conservation actions/ funding decisions to consider climate change; planning; education/outreach	NOAA, NAWCA, PFW, Coastal Program, NRCS, NGOs, VDCR-DNH, VDGIF, VDOF, landowners
demographic constraints	genetics, isolated populations, small population size, etc.	spills	H	all species	spill prevention/planning; respond to spills as needed; work with others on training for spill response; follow through with NRDAR where appropriate	EC, CPA, ES, NWRS, USCG, VDEQ, NOAA, EPA
non-native/ problematic	intentionally left blank	climate change	H	all species	implement appropriate control measures; planning; habitat restoration; outreach/education; monitoring	Coastal Program, NOAA, NAWCA, PFW, EC, NWRS,

native species					for disease outbreaks	USDA, USGS, VDGIF, VDCR-DNH, localities, NOAA, VIMS, VDOF, landowners
non-native/ problematic native species	intentionally left blank	habitat disturbance	H	all species	restore habitat/protect lands; establish/protect habitat corridors; education/outreach	Coastal Program, NOAA, NAWCA, PFW, ES, NWRS, NRCS, NGOs, landowners
disease	intentionally left blank	climate change	H	all species	restore habitat/protect lands; establish/protect habitat corridors; education/outreach	Coastal Program, NOAA, NAWCA, PFW, ES, NWRS, NRCS, NGOs, landowners
habitat loss/ degradation/ fragmentation	instream flow – alterations	deforestation	M	aquatics	provide funds for replanting and land protection; work with TNC on SHAs; facilitate acquisition of timber rights; outreach to forest landowners on LLP restoration	NAWCA, PFW, ES, NRCS, NGOs, landowners
habitat loss/ degradation/ fragmentation	instream flow – alterations	dams - existing, operation and maintenance, and removal, new – proposed	M	all species	removal of dams (low priority); work with FAC; outreach to dam owners on effects of dams and options for removal/modification	PFW, CPA, NOAA, NGOs, ES, VDGIF, FAC, landowners
habitat loss/ degradation/ fragmentation	sedimentation	agricultural runoff	M	aquatics	restore riparian; work with NRCS and SWCDs to implement BMPs; landowner outreach	NAWCA, PFW, NRCS, SWCDs, NGOs, landowners
habitat loss/ degradation/ fragmentation	sedimentation	forestry runoff	M	aquatics	work with VDOF on BMP implementation; restore forests; landowner outreach	PFW, NRCS, VDOF, VDGIF, VDCR-DNH, NGOs, landowners
habitat loss/ degradation/ fragmentation	contaminants	air pollution (including mercury)	M	all species	promote carbon sequestration; permit review	EC, PFW, CPA
habitat loss/ degradation/ fragmentation	contaminants	agricultural run-off/ pesticides	M	all species	buffer restoration and protection work with VDACS	Coastal Program, NAWCA, PFW, NRCS, SWCD, NGOs, EC, VDACS, landowners
habitat loss/ degradation/ fragmentation	contaminants	forestry runoff/pesticides	M	all species	buffer restoration and protection work with VDACS, VDOF	Coastal Program, NAWCA, PFW, NRCS, SWCD, NGOs, EC, VDACS, VDOF, landowners
habitat loss/ degradation/ fragmentation	hydrologic alterations	construction/land disturbance	M	all species	support E&S regulations; develop enhanced E&S control; work with localities; change buffer regulations	ES, CPA, VDCR, localities
habitat loss/ degradation/ fragmentation	nutrient loading	livestock	M	aquatics	restore/protect habitat buffers; work with NRCS and SWCD to implement BMPs	Coastal Program, NAWCA, PFW, NRCS, SWCD, NGOs, EC, landowners
demographic constraints	genetics, isolated populations, small population size, etc.	agriculture/forestry	M	all species	restore habitat/protect lands; establish/protect habitat corridors; prioritize conservation actions/ decisions to promote connectivity; planning; education/outreach	Coastal Program, NOAA, NAWCA, PFW, ES, NWRS, NRCS, NGOs, landowners
demographic constraints	genetics, isolated populations, small population size, etc.	low reproductive viability in existing patchy habitat	M	listed species, migratory	restore habitat/protect lands; connectivity/corridors; permit reviews	Coastal Program, NOAA, NAWCA, PFW, ES, NWRS, NRCS, CPA, NGOs, landowners

				birds		
non-native/ problematic native species and diseases	intentionally left blank	boats as vectors	M	aquatics	intentionally left blank	Intentionally left blank
non-native/ problematic native species and diseases	intentionally left blank	non-native introduction/ spread (plants and animals)	M	all species	planting lists for restoration projects; work with state and local invasive species task force	CPA, ES, PFW, Coastal Program, FAC, EC, state agencies
non-native/ problematic native species and diseases	intentionally left blank	habitat disturbance (forestry, development, agriculture, etc.)	M	all species	implement appropriate control measures; planning; habitat restoration; outreach/education; monitoring for outbreaks; comment on permits	Coastal Program, NOAA, NAWCA, PFW, EC, NWRS, USDA, USGS, VDGIF, localities, NOAA, VIMS, CPA, NGOs, landowners
disease	intentionally left blank	non-native species	M	all species	restore habitat; landowner outreach/education	Coastal Program, NAWCA, PFW, USDA, SWCD, VDGIF, NGOs, landowners
habitat loss/ degradation/ fragmentation	hydrologic alterations	fill (instream and associated wetlands)	L	migratory birds, fish, listed species	land protection; restore wetlands and streams; permit review; work with DoD on Integrated Natural Resources Management Plans	ES, PFW, CPA, NGOs, Coastal Program, NOAA, NAWCA , DoD, landowners
habitat loss/ degradation/ fragmentation	hydrologic alterations	ditches/tile drains	L	migratory birds, fish, listed species	restore wetlands; work with NRCS; land protection	Coastal Program, NAWCA, PFW, CPA, NGOS, NOAA, NRCS, VDGIF, landowners
habitat loss/ degradation/ fragmentation	habitat alteration/ fragmentation (including migration impacts)	deforestation	L	all species	work with DoD/ACUB program, USFS, VDOF, NRCS, VDCR, NGOs to restore forests and strategically reduce fragmentation	PFW, Coastal Program, VDOF, VDCR, NRCS, NGOs, landowners
demographic constraints	genetics, isolated populations, small population size, etc.	dams – large	L	aquatics	remove dams or modify for fish passage: outreach to dam owners on effects of dams and options for removal/modification	PFW, Coastal Program, FAC, NGOs, landowners
demographic constraints	genetics, isolated populations, small population size, etc.	dams – small	L	aquatics	remove dams or modify for fish passage; outreach to dam owners on effects of dams and options for removal/modification	PFW, Coastal Program, FAC, NGOs, landowners
demographic constraints	genetics, isolated populations, small population size, etc.	flood reduction/clean up channel	L	aquatics	Provide comments to NRCS on EWP projects; provide natural stream channel design tech assistance	PFW, ES, CPA, VDGIF, NRCS
demographic constraints	genetics, isolated populations, small population size, etc.	instream sand and gravel mining	L	aquatics	work with VDMME, VMRC	CPA, ES, VDMME, VMRC
demographic constraints	genetics, isolated populations, small population size, etc.	sedimentation	L	aquatics	restore habitat/protect lands	PFW, Coastal Program, NOAA, NAWCA, NGOs, landowners

demographic constraints	genetics, isolated populations, small population size, etc.	highway development/ maintenance	L	all species	appropriate culvert sizing and placement for fish passage; road underpasses; recommend bridges vs culverts/fill	CPA, VDOT, PFW, Coastal Program
demographic constraints	genetics, isolated populations, small population size, etc.	residential/commercial development	L	all species	land protection; encourage local zoning; permit review; review county water supply plans; work with counties to leave corridors intact	Coastal Program, NOAA, NAWCA, PFW, ES, NWRS, NRCS, CPA, NGOs
habitat loss/ degradation/ fragmentation	hydrologic alterations	agricultural water withdrawal	L	migratory birds, fish, listed species	land protection; restore wetlands and streams	PFW, NGOs, Coastal Program, NOAA, NAWCA, landowners
habitat loss/ degradation/ fragmentation	hydrologic alterations	residential/industrial water withdrawal (surface and groundwater)	L	migratory birds, fish, listed species	permit review; work with VDEQ and localities on water supply planning	CPA, VDEQ, ES
habitat loss/ degradation/ fragmentation	hydrologic alterations	instream sand and gravel mining	L	aquatics	work with VDMME, VMRC	CPA, ES, VDMME, VMRC
habitat loss/ degradation/ fragmentation	nutrient loading	aging septic systems/ straight pipes	L	aquatics	work with VDEQ	EC, RC&Ds, VDEQ
habitat loss/ degradation/ fragmentation	nutrient loading	animal waste storage facilities	L	aquatics	work on regulations with VDEQ; comment on discharge permits; review USDA BMP specifications	EC, PFW, VDEQ, USDA, SWCD
habitat loss/ degradation/ fragmentation	nutrient loading	agricultural fertilizer	L	aquatics	restore/protect habitat buffers; work with NRCS and SWCD to implement BMPs	Coastal Program, NAWCA, PFW, NRCS, SWCD, NGOs, landowners
habitat loss/ degradation/ fragmentation	nutrient loading	biosolids application	L	aquatics	restore/protect habitat buffers; work with VDEQ on regulations	EC, Coastal Program, NAWCA, PFW, NRCS, SWCD, NGOs, landowners
habitat loss/ degradation/ fragmentation	contaminants	point source discharges (municipal or industrial wastewater treatment plants - endocrine disruptors, personal care products, pharmaceuticals, etc.)	L	all species	work with EPA on developing regulations	EC

[1]Includes impact occurring now and likelihood of threat in near-term future. Regarding climate change we are uncertain of the appropriate assessment of threat in some instances and additional data may change a specific assessment of threat over time. Rows with high level threats are highlighted.

[2]See "Service Trust Resources" section.

[3]Significant outreach and inreach efforts are inherent in many activities and specific actions are noted.

[4]"All" refers to all programs in Ecological Services.

CLINCH AND POWELL RIVERS WATERSHED PRIORITY AREA THREATS ASSESSMENT						
Category	**Threat**	**Trust Resources Affected[1]**	**Stressor**	**Assessment of Threat on Species[2] (high, medium, low)**	**What Ecological Services Can Do[3]**	**Who Can Address Problem[4]**
agriculture	livestock	aquatics, karst species	nutrient loading, chemical contamination, sedimentation, stream instability, trampling	H	restore/protect habitat; work with NRCS and SWCDs to improve and implement BMPs; outreach on BMPs and cost share programs to farmers	NRCS, SWCD, PFW, VDGIF, ES, VDCR, localities, NGOs, landowner
agriculture	pasture and cropland development/ maintenance	all species	habitat degradation, fragmentation, and loss	H	habitat restoration and protection; encourage BMPs; outreach to farmers	PFW, USDA, SWCD, VDCR, NGOs, landowner
climate change	climate change	aquatics	change in instream temperatures	H	habitat restoration and protection; proactive planning regarding habitat availability, habitat/ species shifts; promote alternative energy usage; public outreach on climate change and benefits of energy conservation and alternative energy development	PFW, ES, VDGIF, USGS, NOAA, NGOs, universities, EPA, VDEQ, VDMME, OSM, FERC, landowner
climate change	climate change	all species	change in flow/hydrologic regime	H	work with partners on models and research projects to inform; assess potential need for refugia populations; promote alternative energy usage; habitat restoration and protection; water conservation and supply planning; public outreach on climate change and benefits of alternative energy development	PFW, ES, VDGIF, USGS, NOAA, NGOs, FERC, VDMME, OSM, localities, universities, VDEQ, EPA, VDMME, landowners
climate change	climate change	all species	shift in native species/non-native species/diseases	H	identify the threat and monitor for occurrence; conduct vulnerability assessments and develop response plans; habitat restoration/protection; public outreach on climate change and benefits of energy conservation and alternative energy development	VDACS, USGS, VDGIF, Corps, VDEQ, localities, VDOT, PFW, ES, CPA, USDA, TVA, EC, NGOs, landowners
climate change	human migration/ relocation	all species	pollution, habitat loss	H	habitat restoration/protection; public outreach on climate change and benefits of energy conservation and alternative energy development	PFW, USDA, NGOs, landowners
mining	runoff from abandoned mine lands (including acid mine drainage)	aquatics, migratory birds, bats	contaminants, sedimentation	H	provide FWCA reports and technical assistance to Corps and others; review AML "emergency" projects and AML grant projects including water and sewer line installation; monitor to determine success of AML projects; use NRDAR funds for projects/	ES, EC, CPA, VDMME, Corps, PDCs, EPA, VDEQ, Congress

					matching funds; encourage Lands Unsuitable for Mining designation; acquire subsurface rights in sensitive areas; outreach on AML environmental priorities to regulators and congress	
mining	channelization/ instream modifications and fill	aquatics, bats, migratory birds	instream flows - alterations, habitat loss/degradation	H	work with VMRC, Corps, VDEQ, VDOT on permit review and enforcement; land protection, habitat restoration; evaluation/assessment of threat; work with localities to establish floodplain and buffer regulations; participate in partnerships/planning; promote natural stream channel design; work with VDMME on SSPMs; encourage Lands Unsuitable for Mining designation; acquire subsurface rights in sensitive areas; outreach on environmental impacts of mining and of benefits energy conservation and alternative energy development	EC, CPA, PFW, FAC, NRCS, EPA, USGS, VDMME, VDEQ, VDOT, ES, VDGIF, VMRC, Corps
mining	point source effluents (e.g., sedimentation ponds, valley fill ponds, coal preparation plants)	aquatics	contaminants, sedimentation	H	continue to partner with USGS on SSP studies; review VDMME and Corps permit applications; work on SSPMs under 1996 OSM BO; review draft TMDLs and provide comments to VDEQ and VDMLR; encourage better cumulative impacts assessment in NEPA documents and mining review comments; encourage Lands Unsuitable for Mining designation; acquire subsurface rights in sensitive areas; outreach on environmental impacts of mining and benefits of energy conservation and alternative energy development	ES, CPA, EC, VDOF, VDMLR, OSM, NGOs, EPA, USFS, VDEQ, Corps, VDGIF, VDMME, universities, USGS
mining	non-point source run-off	aquatics	contaminants, sedimentation	H	review VDMME and Corps permit applications; work on SSPMs under 1996 OSM BO; review draft TMDLs and provide comments to VDEQ and VDMLR; encourage Lands Unsuitable for Mining designation; acquire subsurface rights in sensitive areas; outreach on environmental impacts of mining and benefits of energy conservation and alternative energy development	ES, CPA, EC, VDOF, VDMLR, OSM, NGOS, EPA, USFS, VDEQ, Corps, VDGIF, VDMME, universities, USGS
mining	re-mining	aquatics	contaminants, sedimentation	H	review VDMME and Corps permit applications; work on SSPMs under 1996 OSM BO; review draft TMDLs and provide comments to VDEQ and VDMLR; encourage Lands Unsuitable for Mining designation; acquire subsurface rights in sensitive areas; outreach on impacts of mining contaminants to industry and regulators	ES, CPA, EC, VDOF, VDMLR, OSM, NGOS, EPA, USFS, VDEQ, Corps, VDGIF, VDMME, universities, USGS
gas	mining runoff	aquatics	sedimentation	H	review permit applications; work on SSPMs under 1996 OSM BO; acquire subsurface rights in sensitive areas; outreach on environmental impacts of gas drilling and benefits of energy conservation and	EC, CPA, ES, OSM, VDMME, Corps, VDMLR, EPA, VDEQ

					alternative energy development	
gas	coal-bed methane	aquatics, migratory birds, bats	contaminants, sedimentation, habitat loss/fragmentation	H	HCPs; work with VDMME on BMPs and permits; review EPA deep well injection permits; work with industry to minimize impacts; acquire subsurface rights in sensitive areas; outreach on environmental impacts of coal-bed methane production and benefits of energy conservation and alternative energy development	EC, EPA, ES, VDMME, VDEQ, industry, NWRS, NGOs
power generation	carbon burning power plants	all species	contaminants (air and water), habitat loss/fragmentation, water withdrawal	H	consult where there is a Federal nexus; encourage EPA/VDEQ involvement; monitor, work with industry to minimize impacts; outreach on environmental impacts of carbon-burning plants and benefits of energy conservation and alternative energy development	EC, ES, CPA, EPA, VDEQ, industry, Corps, VSCC, localities, USGS
recreation	caving/vandalism	bats, isopod	habitat loss/degradation, direct mortality, disease vector	H	promote cave gating; research associated with disease vectors; outreach to cavers and landowners about disease vectors and caving impacts	ES, VDGIF, VDCR, USGS, universities, USFS, VDMLR, NPS, NGOs, PFW, landowners
transportation	spills	aquatics	contaminants	H	respond to spills as needed, follow through with NRDAR where appropriate; work with agencies/ industry on rail, bridge and road design; outreach on signs at bridge crossings and watershed divides (e.g., "Entering UTRB watershed") and via brochures and websites with links on how to report spills	EC, VDOT, industry, FHWA, CPA, ES, FRA, localities, citizens
transportation	highway, airport, and rail development/ maintenance (including runoff and pesticide applications)	all species	habitat loss/degradation/ fragmentation, contaminants	H	section 7 consultations; work with localities; BMPs; karst protection; planning to avoid sensitive areas; stormwater management; monitoring to assess contaminant levels; outreach to transportation industry and public via signage (see cell above)	EC, CPA, ES, VDOT, localities, VDCR, NGOs, FHWA, FRA, FAA
urbanization and commercial/ industrial development	construction/land disturbance	all species	habitat loss/ degradation/ fragmentation, sedimentation, contaminants, instream flow alteration, degradation of karst systems	H	support erosion and sediment regulations; develop enhanced erosion and sediment control for listed species; monitoring to assess contaminant levels; work with localities on planning and zoning; outreach to communities and landowners on BMPs	ES, PDCs, IDA, USDA, RC&Ds, SWCD, CDBG, NGOs, CPA, EC, VDOF, USFS, VDEQ, VDGIF, universities, USGS, localities, landowners
demography	poor demography	all species	low reproductive viability in existing patchy habitat, small population size, genetic drift, demographic stochasticity	H	propagation and reintroduction to suitable habitat; conduct population modeling and viability analysis and perform candidate assessments; assess threat; assess genetic differences among remaining populations; outreach to funding sources and interagency groups on problem	ES, universities, USGS, VDGIF, VDCR, TVA, FAC
right-of-way development	utility corridors	all species	habitat loss/fragmentation/ degradation	H	support E&S regulations; develop enhanced E&S controls for listed species; consult and plan to avoid	localities, ES, CPA, FERC, VSCC, industry, TVA, Corps, VDGIF,

and maintenance					sensitive areas; permit reviews; work with localities on planning and zoning; outreach to industry on impacts and to public on benefits of energy conservation and alternative energy development (e.g., passive and local stored solar).	VDCR, VDEQ, USDA, VDOT
agriculture	pesticide runoff	aquatics, karst species	contaminants	M	riparian restoration and protection, outreach to farmers on benefits of proper pesticide usage	EC, PFW, ES, USDA, EPA, VDGIF, SWCD, NGOs, VDEQ, landowners
agriculture	sediment runoff	aquatics, karst species	sedimentation	M	restore/protect habitat; work with NRCS and SWCDs to improve and implement BMPs; outreach on BMPs to farmers	NRCS, SWCD, PFW, VDGIF, ES, USGS, VDCR, localities, NGOs, landowners
agriculture	biosolids application	aquatics, karst species, migratory birds	nutrient loading, biological oxygen demand, eutrophication, chemical contamination	M	riparian restoration and protection; work with VDEQ on permits/regulations; outreach on BMPs and regulations to farmers	EC, VDEQ, ES, PFW, NGOs, landowners
agriculture	fertilizer	aquatics	nutrient loading	M	riparian restoration and protection; work with VDCR and USDA on BMPs, guidance, regulations; outreach on organic farming and BMPs to farmers	EC, VDCR, USDA, PFW, SWCD, NGOS, landowners
agriculture	sinkhole dumps	aquatics, karst species	contaminants	M	encourage sinkhole cleanup and protection; outreach on waste disposal to farmers	VDGIF, PFW, ES, NRCS, EC, VDCR, NGOs, landowners
mining	deforestation	all species	instream flows - alterations, sedimentation, contaminants, habitat loss/fragmentation	M	encourage Forestry Reclamation Approach for mining; consult with USFS where applicable; obtain conservation easements; encourage deep mining instead of surface mining where possible; encourage Lands Unsuitable for Mining designation; acquire subsurface rights in sensitive areas; outreach on environmental impacts of mining and benefits of energy conservation and alternative energy development	ES, EC, CPA, VDMME, OSM, Corps, USFS, VDOF, VDGIF, EPA, USGS, landowners
gas	Marcellus shale	aquatics	instream flows - alterations, sedimentation, contaminants, habitat loss/ fragmentation	M	coordinate with VDMME and VDEQ on permits and instream monitoring (chemical and biotic); HCPs; collaborative research; acquire subsurface rights in sensitive areas; outreach on environmental impacts of Marcellus Shale drilling and benefits of alternative energy development	EC, CPA, USGS, EPA, VDEQ, VDMME, VDMLR, ES, universities
power generation	dams	all species	instream flows - alterations, habitat alteration/ fragmentation (including migration impacts), sedimentation, thermal impacts	M	work with Cookeville FO and TVA to comment on large dams; comment on FERC regulatory permits; facilitate fish connectivity through population augmentation; outreach on potential environmental impacts of dam operations and benefits of energy conservation and alternative energy development	CPA, EC, ES, FAC, TVA, FERC, VDGIF
wind turbines	wind turbines	migratory birds, bats	habitat alteration/ fragmentation (including migration impacts), direct mortality	M	land protection; HCPs; work with industry; develop BMPs and regulations with state permitting agencies and localities; identify sensitive areas that are of most concern; section 7 when appropriate; explore	ES, localities, CPA, industry, VDEQ, VDGIF, NGOs, USFS, NPS, VSCC, FERC

					financial incentives to protect areas of concern; outreach on potential environmental impacts of wind turbines and benefits of energy conservation and alternative energy development	
mill ponds	small dams	aquatics	instream flows - alterations, habitat alteration/ fragmentation (including migration impacts), sedimentation, thermal impacts	M	work with dam owners on removal and modification; facilitate fish connectivity through population augmentation; outreach on benefits of fish passage and impacts of small dams	PFW, USDA, ES, SWCD, NRDAR, VDOT, landowners, VDGIF, NGOs, localities
recreation	introduction of non-natives/ disease/pet trade	aquatics	competition, habitat loss/ displacement, reduced viability	M	surveillance for introduced species and develop response plan; encourage outreach; work with pet trade and state agencies on regulations; outreach to boat and pet owners and anglers about problems and how to avoid them	VDGIF, ES, industry, VDCR, anglers
forestry	deforestation/ forest type conversion, run-off	all species	Instream flows - alterations, habitat loss/degradation/ fragmentation, invasive species, sedimentation	M	land protection; HCPs; work with industry; develop BMPs and regulations with state permitting agencies and localities; identify sensitive areas that are of most concern; section 7 when appropriate; explore financial incentives to protect areas of concern; promote forest management planning; GAP analysis to identify riparian restoration needs; outreach to landowners on BMPs	CPA, ES, VDOF, USFS, localities, landowners, industry, NGOS, Migratory Birds, PFW, EC
forestry	pesticide application (including Bt for gypsy moths)	all species	contaminants, habitat degradation, mortality of non-target organisms	M	work with agencies on long-term management plans and non-programmatic projects; work with EPA on label requirements; outreach on pesticide BMPs	ES, EC, CPA, USDA, VDACS, EPA, VDOF
urbanization and commercial/ industrial development	growth related point and non-point waste (e.g., lawn care)	aquatics	nutrient loading, contaminants, sedimentation	M	develop permits limits; support E&S regulations; develop BMPs and enhanced E&S controls for listed species; monitoring to assess contaminant levels; work with localities on planning and zoning; outreach to localities on impacts and BMPS	landowners, ES, PDCs, IDA, USDA, RC&Ds, SWCD, CDBG, NGOs, CPA, EC, VDOF, VDEQ, VDGIF, universities, USGS, localities, VDMME, Corps
urbanization and commercial/ industrial development	straight pipes	aquatics	nutrient loading, contaminants, sedimentation	M	monitoring to assess contaminant levels; work with localities on planning; research VDOH records to determine where straight pipes are a concern; encourage installation of proper sewage treatment and/or relocation of homes; facilitate funding to correct straight pipes in key areas; outreach to localities on impacts and BMPs	landowners, ES, PDCs, USDA, RC&Ds, SWCD, CDBG, NGOs, CPA, EC, VDEQ, VDGIF, universities, USGS, localities, VDMME, VDOH, Corps, EPA
urbanization and commercial/ industrial development	landfill leachate/ roadside dumps/ littering/waste transfer stations	aquatics	contaminants	M	monitoring to assess threats and contaminants level; identify location of current and historic landfills/ waste dumps; develop appropriate regulations and work with localities to implement regulations; work with localities on siting of facilities; cleanup old dump	CPA, ES, USGS, VDEQ, localities, RC&Ds, EC, PDCs, EPA, VDCR

					facilities; encourage door-to-door pickup and waste disposal; outreach to localities on impacts and BMPS	
urbanization and commercial/ industrial development	water supply (wells, surface water withdrawal, inter intra basin transfer)	aquatics, karst species	instream flows - alterations	M	comment on VDEQ/Corps regulatory permits; work with VDEQ to lower the reporting threshold for water withdrawals; review county water supply plans provided to VDEQ; work with RC&Ds and PDCs on water supply planning; develop instream flow models for trust resources; develop water conservation plans; oppose inter intra basin transfer in sensitive areas; review USDA/ FSA/HUD loans for water development and promote water conservation; outreach to localities on growth impacts and water conservation	USGS, NGOs, VMRC, TVA, PFW, USDA, EPA, VDEQ, Corps, HUD, RC&D, PDC, USDA, localities, landowners
agriculture	water withdrawal	aquatics	instream flows - alterations	L	work with VDEQ to lower the water withdrawal reporting threshold; outreach on water conservation to farmers and alternative watering supplies	All, FAC, VDEQ, NGOs, USGS, landowners
agriculture	failure/seepage/ overflow of animal waste storage facilities	aquatics, karst species	nutrient loading, biological oxygen demand, eutrophication, chemical contamination	L	assist with enforcement and cost share to remedy; outreach on containments impacts and prevention to farmers	PFW, EC, ES, OLE, VDEQ, VDCR, USDA, landowners
agriculture	ditches/tile drains	aquatics	instream flows - alterations	L	restore hydrology; review Corps permits and Swampbuster; outreach to farmers on wetlands benefits and cost share programs	PFW, Corps, USDA, SWCD, VDEQ, RC&D, landowners
agriculture	spring development	aquatics	instream flows - alterations	L	request NRCS to report all spring development annually to VDEQ/Corps; outreach on alternative water supplies and BMPs to farmers	PFW, VDEQ, Corps, NRCS, landowners
aquaculture	hatchery development/ maintenance	aquatics	excessive nutrients, introduction of exotic species, pathogen spread	L	assess future threat and monitor existing threat; outreach on BMPs to private hatcheries	VDEQ, VDGIF, hatchery operators
recreation	ORUV	all species	direct destruction of habitat, noise disturbance	L	work with landowners; fence trails; work with ORUV manufacturers about habitat destruction; establish ORUV trails; outreach about ORUV impacts by use of signs and brochures	PFW, OLE, VDACS, localities, industry, ES, VDGIF LE, USFS, VDOF, VDCR, landowners
forestry	prescribed burning	all species	habitat alteration, smoke, contaminants, run-off, direct mortality	L	promote forest management planning that considers trust resources; BMPs; consult on listed species; facilitate prescribed burning to improve habitat; outreach to landowners on BMPS	CPA, PFW, ES, USFS, VDOF, USDA, VDCR, VDGIF, NGOS, TVA , landowners
urbanization and commercial/ industrial development	flood control	aquatics	instream flow alteration, habitat loss/degradation/ fragmentation	L	review permit applications; report and encourage action on violations; habitat restoration; outreach to landowners and localities on growth impacts and stormwater management	ES, localities, Corps, VMRC, TVA, landowners, CPA, PDCs
[1]See "Service Trust Resources" section.						

[2]Includes impact occurring now and likelihood of threat in near-term future. Regarding climate change we are uncertain of the appropriate assessment of threat in some instances and additional data may change a specific assessment of threat over time. Rows with high level threats are highlighted.
[3]Significant outreach and inreach efforts are inherent in many activities and species actions are noted.
[4]"All" refers to all programs in Ecological Services.

EASTERN SHORE PRIORITY AREA THREATS ASSESSMENT						
Threat	**Stressor**	**Cause**	**Assessment of Threat on Species[1] (high, medium, low)**	**Trust Resources Affected[2]**	**What Ecological Services Can Do[3]**	**Who Can Address Problem[4]**
habitat loss/ degradation/ fragmentation	hydrologic alterations	ditches/tile drains	H	migratory birds, fish	restore wetlands; work with NRCS; land protection; outreach/education agriculture and forestry landowners	Coastal Program, NAWCA, PFW, CPA, NGOs, NWRS, NOAA, landowners
habitat loss/ degradation/ fragmentation	hydrologic alterations	climate change	H	all species	establish (protect/restore) habitat corridors	Coastal Program, NAWCA, PFW, CPA, NGOs, NWRS, NOAA, ES, landowners
habitat loss/ degradation/ fragmentation	sedimentation	agricultural runoff	H	migratory birds, fish	restore habitats; work with NRCS and SWCDs to implement BMPs	Coastal Program, NOAA, NAWCA, PFW, NRCS, CPA, landowners
habitat loss/ degradation/ fragmentation	nutrient loading	animal waste storage facilities	H	migratory birds, fish	work on regulations with VDEQ; comment on discharge permits; review USDA BMPs	EC, PFW, VDEQ, USDA
habitat loss/ degradation/ fragmentation	nutrient loading	agricultural fertilizer	H	migratory birds, fish	restore/protect habitat buffers	Coastal Program, NOAA, NAWCA, PFW, NRCS, SWCD, NGOs, NOAA, landowners
habitat loss/ degradation/ fragmentation	contaminants	spills (on and off shore)	H	all species, NWR lands	spill prevention/planning; respond to spills as needed; work with others on training for spill response; follow through with NRDAR where appropriate	EC, CPA, ES, NWRS, USCG, VDEQ, NOAA, EPA
habitat loss/ degradation/ fragmentation	contaminants	agricultural (poultry/row crops) run-off	H	migratory birds, fish	buffer restoration and protection	EC, PFW, USGS, NRCS, SWCD, landowners
habitat loss/ degradation/ fragmentation	shifts in native communities/ species composition (including non-natives)	climate change	H	all species	restore habitat/protect lands; establish/protect habitat corridors; prioritize conservation actions/funding decisions to consider climate change; control invasives	NOAA, NAWCA, All, NWRS, NRCS, NGOs
habitat loss/ degradation/ fragmentation	human migration/ relocation	climate change	H	all species	restore habitat/protect lands;	NOAA, NAWCA, PFW, Coastal Program, NWRS, NRCS, NGOs, landowners
habitat loss/ degradation/ fragmentation	sea level rise	climate change	H	all species	restore habitat/protect lands; establish/protect habitat corridors; prioritize conservation actions/funding decisions to consider climate change; planning; education/outreach to localities	NOAA, NAWCA, PFW, Coastal Program, NWRS, NRCS, NGOs landowners
habitat loss/ degradation/	increased drought/	climate change	H	all species	work with VDEQ on water supply planning to include trust resource needs; restore habitat/protect lands	VDEQ, PFW, Coastal Program, NWRS, NRCS, NGOs

fragmentation	increased rainfall/ temperature change					
habitat loss/ degradation/ fragmentation	increased storm events resulting from climate change	climate change	H	all species	restore habitat/protect lands; establish/protect habitat corridors; prioritize conservation actions/funding decisions to consider climate change; planning; education/outreach to localities	NOAA, NAWCA, PFW, Coastal Program, NWRS, NRCS, NGOs, landowners
habitat loss/ degradation/ fragmentation	habitat alteration/ fragmentation (including migration impacts)	deforestation	H	migratory birds, fish, listed species	work with VDOF, NRCS to restore forests and strategically reduce fragmentation; outreach and education to forest landowners	PFW, Coastal Program, VDOF, VDCR, NRCS, NGOs, VDEQ, NWRS, landowners
habitat loss/ degradation/ fragmentation	shoreline alteration	sea level rise	H	all species	restore habitat/protect lands; establish/protect habitat corridors; prioritize conservation actions/funding decisions to consider climate change; planning; education/outreach, primarily to localities	Coastal Program, NOAA, NAWCA, PFW, NWRS, NRCS, NGOs landowners
habitat loss/ degradation/ fragmentation	shoreline alteration	increased storm events	H	all species	restore habitat/protect lands, establish/protect habitat corridors, prioritize conservation actions/funding decisions to consider climate change, planning, education/outreach, primarily to localities	Coastal Program, NOAA, NAWCA, PFW, NWRS, NRCS, NGOs, landowners
habitat loss/ degradation/ fragmentation	shoreline alteration	bulkheads/riprap	H	coastal species	permit review to encourage less destructive measures and minimize impacts; look for funding to assist landowners to offset their costs for alternate shoreline protection (living shoreline); outreach/education to public, localities, permitting agencies; buy shoreline habitat; encourage shoreline protection/planning in a regional context	Coastal Program, NOAA, NAWCA, CPA, ES, NGOs, NOAA, VIMS, Corps, VMRC, localities, landowners
non-native/ problematic native species and diseases	intentionally left blank	climate change	H	all species	implement appropriate control measures; planning; habitat restoration; outreach/education with landowners and Plant ES Natives campaign; monitoring for disease outbreaks	Coastal Program, NOAA, NAWCA, PFW, EC, NWRS, USDA, USGS, VDGIF, localities, NOAA, VIMS
non-native/ problematic native species and diseases	intentionally left blank	habitat disturbance (forestry, development, agriculture, etc.)	H	all species	implement appropriate control measures; planning, habitat restoration; outreach/education; monitoring for outbreaks; comment on permits	Coastal Program, NOAA, NAWCA, PFW, EC, NWRS, USDA, USGS, VDGIF, localities, NOAA, VIMS, CPA
habitat loss/ degradation/ fragmentation	hydrologic alterations	agricultural instream water withdrawal from impoundments	M	migratory birds, fish	land protection; restore wetlands and streams	PFW, NGOs, NWRS, Coastal Program, NOAA, NAWCA, landowners
habitat loss/ degradation/ fragmentation	hydrologic alterations	dams (existing - operation and maintenance, removal; new - proposed)	M	migratory birds, fish	removal of dams (low priority) outreach to private dam owners	PFW, CPA, NOAA, NGOs, NWRS, FAC, landowners
habitat loss/	hydrologic	dredging for	M	migratory	review permits	CPA, ES

degradation/ fragmentation	alterations	navigation		birds, fish		
habitat loss/ degradation/ fragmentation	nutrient loading	biosolids application	M	migratory birds, fish	restore/protect habitat buffers; work with VDEQ on regulations	Coastal Program, NOAA, NAWCA, EC, PFW, VDEQ, USDA, NGOs, landowners
habitat loss/ degradation/ fragmentation	contaminants	point source discharges (municipal or industrial wastewater treatment plants - endocrine disruptors, personal care products, pharmaceuticals, etc.)	M	all species	work with EPA on developing regulations	EC
habitat loss/ degradation/ fragmentation	habitat alteration/ fragmentation (including migration impacts), direct mortality	wind turbines	M	migratory birds, bats	land protection; HCPs; work with industry; develop BMPs and regulations with state permitting agencies and localities; identify sensitive areas that are of most concern; section 7 when appropriate; explore financial incentives to protect areas of concern	ES, localities, CPA, industry, VDEQ, VDGIF, NGOs, USFS, NPS, VSCC, FERC
habitat loss/ degradation/ fragmentation	shoreline alteration	groins/jetties	M	coastal species	permit review to encourage less destructive measures; look for funding to assist landowners to offset their costs for alternate shoreline protection (living shoreline); outreach/education to public, localities, permitting agencies; buy shoreline habitat; encourage shoreline protection/planning in a regional context	Coastal Program, NOAA, NAWCA, CPA, ES, NGOs, NOAA, VIMS, Corps, VMRC, localities, landowners
non-native/ problematic native species and diseases	intentionally left blank	boats - ballast water	M	Aquatics	intentionally left blank	Intentionally left blank
non-native/ problematic native species and diseases	intentionally left blank	non-native introduction/spread (plants and animals)	M	all species	planting lists for restoration projects; work with state and local invasive species task force; outreach/education with landowners and Plant ES Natives campaign	CPA, ES, PFW, Coastal, FAC, EC, state agencies
non-native/ problematic native species and diseases	intentionally left blank	pollution (e.g., immune response effects)	M	all species	habitat restoration; work with regulatory agencies	Coastal Program, NOAA, NAWCA, PFW, EC, VDEQ, EPA, NGOs, landowners
habitat loss/ degradation/ fragmentation	hydrologic alterations	fill (instream and associated wetlands)	L	migratory birds, fish	land protection; restore wetlands and streams	PFW, CPA, NWRS, NGOs, Coastal Program, NOAA, NAWCA, landowners
habitat loss/	hydrologic	deforestation	L	migratory	land protection; restore forests; facilitate acquisition of timber	PFW, NWRS, NGOs, Coastal

degradation/ fragmentation	alterations			birds, fish	rights	Program, NOAA, NAWCA, landowners
habitat loss/ degradation/ fragmentation	hydrologic alterations	truck crop farming (plasticulture)	L	migratory birds, fish	restore aquatic habitat buffers	PFW, NRCS, VDCR, landowners, NGOs
habitat loss/ degradation/ fragmentation	hydrologic alterations	water supply (wells)	L	migratory birds, fish	collaborate with VDEQ, NGOs and others to lower reporting threshold for wells, assess influence of climate change, and improve water supply planning decisions	CPA, VDEQ, EPA, USGS
habitat loss/ degradation/ fragmentation	sedimentation	dredging for navigation/spoil placement	L	migratory birds, fish	review permits	CPA, ES
habitat loss/ degradation/ fragmentation	sedimentation	forestry runoff	L	migratory birds, fish	work with VDOF on BMP implementation, restore forests	Coastal Program, NOAA, NAWCA, PFW, NWRS, NGOs, landowners
habitat loss/ degradation/ fragmentation	sedimentation	construction/land disturbance	L	migratory birds, fish	support E&S regulations; develop enhanced E&S control	CPA
habitat loss/ degradation/ fragmentation	nutrient loading	straight pipes/aging septic systems	L	migratory birds, fish	work with VDEQ on discharge rules	EC, RC&Ds, VDEQ
habitat loss/ degradation/ fragmentation	contaminants	forestry pesticides	L	migratory birds, fish	intentionally left blank	Intentionally left blank
habitat loss/ degradation/ fragmentation	contaminants	air pollution	L	all species	intentionally left blank	EC, PFW
habitat loss/ degradation/ fragmentation	shoreline alteration	beach/dune augmentation (including sand dredging)	L	coastal species	permit review to minimize impacts; investigate design standards; look for funding to assist landowners to offset their costs for integrated shoreline protection; outreach/education to public, localities, permitting agencies; buy shoreline habitat; encourage shoreline protection/planning in a regional context	Coastal Program, NOAA, NAWCA, CPA, ES, NGOs, NOAA, VIMS, Corps, VMRC, localities, landowners
habitat loss/ degradation/ fragmentation	shoreline alteration	navigation dredging and associated spoil placement	L	coastal species	permit review to minimize impacts; collaborate on beneficial use of dredge spoil	CPA, ES, PFW, Coastal Program
habitat loss/ degradation/ fragmentation	shoreline alteration	breakwaters	L	coastal species	permit review to minimize impacts; investigate design standards; look for funding to assist landowners to offset their costs for alternate shoreline protection (living shoreline); outreach/ education to public, localities, permitting agencies; buy shoreline habitat; encourage shoreline protection/planning in a regional context	CPA, ES, Coastal Program, NGOs, NOAA, VIMS, Corps, VMRC, localities, landowners
direct disturbance	intentionally left blank	shoreline recreation	L	listed species, migratory birds	outreach/education, support VDCR, VDGIF public education efforts; work with localities; land protection	ES, PFW

direct disturbance	intentionally left blank	Wallops Island operations	L	all species	permit review; work with NASA/military on operational planning	CPA, ES, Corps

[1]Includes impact occurring now and likelihood of threat in near-term future. Regarding climate change we are uncertain of the appropriate assessment of threat in some instances and additional data may change a specific assessment of threat over time. Rows with high level threats are highlighted.

[2]See "Service Trust Resources" section.

[3]Significant outreach and inreach efforts are inherent in many activities and species actions are noted.

[4]"All" refers to all programs in Ecological Services.

HOLSTON RIVER WATERSHED PRIORITY AREA THREATS ASSESSMENT						
Category	**Threat**	**Trust Resources Affected**[1]	**Stressor**	**Assessment of Threat on Species**[2] **(high, medium, low)**	**What Ecological Services Can Do**[3]	**Who Can Address Problem**[4]
agriculture	sediment runoff	aquatics	sedimentation	H	restore/protect habitat; work with NRCS and SWCDs to improve and implement BMPs; develop enhanced E&S controls; outreach on BMPs to farmers	USDA, VDEQ, SWCD, PFW, VDGIF, ES, USGS, VDCR, localities, EC, VDACS, landowners
agriculture	livestock	aquatics	nutrient loading, chemical contamination, sedimentation, stream instability, trampling	H	restore/protect habitat; work with NRCS and SWCDs to improve and implement BMPs; outreach on BMPs and cost share programs to farmers	NRCS, SWCD, PFW, VDGIF, ES, VDCR, localities, NGOs, landowners
agriculture	pasture and cropland development/ maintenance	all species	habitat degradation, fragmentation, and loss	H	habitat restoration and protection; encourage BMPs, outreach to farmers	ES, PFW, USDA, SWCD, VDCR, NGOs, landowners
climate change	climate change	aquatics	change in instream temperatures	H	assess threat; habitat restoration and protection; proactive planning regarding habitat availability, habitat/species shifts; promote alternative energy usage; public outreach on climate change and benefits of energy conservation and alternative energy development	PFW, ES, VDGIF, USGS, NOAA, NGOs, universities, EPA, VDEQ, VDMME, OSM, FERC, landowners
climate change	climate change	all species	change in flow/ hydrologic regime	H	work with partners on models and research projects to inform; assess potential need for refugia populations; promote alternative energy usage; habitat restoration and protection; water conservation and supply planning; public outreach on climate change and benefits of energy conservation and alternative energy development	PFW, ES, VDGIF, USGS, NOAA, NGOs, FERC, VDMME, OSM, localities, universities, VDEQ, EPA, VDMME, landowners
climate change	climate change	all species	shift in native species/non-native species/diseases	H	identify the threat and monitor for occurrence; conduct vulnerability assessments and develop response plans; habitat restoration/protection; public outreach on climate change and benefits of energy conservation and alternative energy development	VDACS, USGS, VDGIF, Corps, VDEQ, localities, VDOT, PFW, ES, NGOs, CPA, USDA, TVA, EC, landowners
climate change	human migration/ relocation	all species	pollution, habitat loss	H	habitat restoration/protection; public outreach on climate change and benefits of energy conservation and alternative energy development	PFW, EC, ES, NGOs, landowners
power generation	carbon-burning power plants	all species	contaminants (air and water), habitat loss/fragmentation	H	consult where there is a Federal nexus; encourage EPA/VDEQ involvement; monitor, work with industry to minimize impacts; coordinated review with NPS and USFS for air pollution permits;	EC, ES, CPA, EPA, VDEQ, industry, Corps, VSCC, localities, USGS, NPS, USFS

					outreach on environmental impacts of carbon-burning plants and benefits of energy conservation and alternative energy development.	
recreation	caving/vandalism	bats	habitat loss/ degradation, direct mortality, disease vector	H	promote cave gating; research associated with disease vectors; work with landowners to control cave access; outreach to cavers and landowners about disease vectors and caving impacts	ES, VDGIF, VDCR, USGS, universities, USFS, VDMLR, NPS, NGOs, PFW, landowners
transportation	spills	aquatics	contaminants	H	respond to spills as needed, follow through with NRDAR where appropriate; work with agencies/industry on rail, bridge and road design; outreach on signs at bridge crossings and watershed divides (e.g., "Entering UTRB watershed") and via brochures and websites with links on how to report spills	EC, VDOT, industry, FHWA, CPA, ES, FRA, localities, citizens
transportation	highway, airport, and rail development/ maintenance (including runoff and pesticide applications)	all species	habitat loss/ degradation/ fragmentation, contaminants	H	section 7 consultations; work with localities; BMPs; karst protection; planning to avoid sensitive areas; stormwater management; monitoring to assess contaminant levels; outreach to transportation industry and public via signage (see cell above)	EC, CPA, ES, VDOT, localities, VDCR, NGOs, FHWA, FRA, FAA
urbanization and commercial/ industrial development	point and non-point waste (e.g., lawn care)	aquatics	nutrient loading, contaminants, sedimentation	H	develop permits limits; support E&S regulations; develop BMPs and enhanced E&S control for listed species; monitoring to assess contaminant levels; work with localities on planning and zoning; address straight pipes; outreach to localities on impacts and BMPs	landowners, ES, PDCs, IDA, USDA, RC&Ds, SWCD, CDBG, CPA, EC, VDOF, NGOs, VDEQ, VDGIF, universities, USGS, localities, VDMME, Corps
urbanization and commercial/ industrial development	legacy point and non-point industrial discharges	all species	mercury (Saltville), contaminants	H	continue NRDAR and work with EPA through the BTAG; NRDAR/ EC studies on legacy sites	EC, EPA, VDEQ, industry, localities, landowners
demography	poor demography	all species	low reproductive viability in existing patchy habitat, small population size, genetic drift, demographic stochasticity	H	propagation and reintroduction to suitable habitat; conduct population modeling and viability analysis and perform candidate assessments; assess threat; assess genetic differences among remaining populations; outreach to funding sources and interagency groups on problem	ES, universities, USGS, VDGIF, VDCR, TVA, FAC, NGOs, Tennessee Wildlife Resources Agency, NRDAR
right-of-way development and maintenance	utility corridors	all species	habitat loss/ fragmentation/ degradation	H	support E&S regulations; develop enhanced E&S control for listed species; consult and plan to avoid sensitive areas; permit reviews; work with localities on planning and zoning; outreach to industry on impacts and to public on benefits of energy conservation and alternative development (e.g., passive and local stored solar)	localities, ES, CPA, FERC, VSCC, industry, TVA, Corps, VDGIF, VDCR, VDEQ, USDA, VDOT
agriculture	pesticide runoff	aquatics, bats	contaminants	M	riparian restoration and protection; outreach to farmers on benefits of proper pesticide usage	EC, PFW, ES, USDA, EPA, VDGIF, SWCD, VDEQ, NGOs, landowners

agriculture	biosolids application	aquatics, migratory birds, bats	nutrient loading, biological oxygen demand, eutrophication, chemical contamination	M	riparian restoration and protection; work with VDEQ on permits/ regulations; outreach to farmers on BMPs and regulations	EC, VDEQ, ES, PFW, NGOs, localities, landowners
agriculture	fertilizer	aquatics	nutrient loading	M	riparian restoration and protection; work with VDCR and USDA on BMPs, guidance, regulations; outreach on organic farming and BMPs to farmers	EC, VDCR, USDA, PFW, SWCD, NGOs, ES, landowners
agriculture	sinkhole dumps	aquatics, bats	contaminants	M	encourage sinkhole cleanup and protection; outreach on waste disposal to farmers	NGOs, VDGIF, PFW, ES, NRCS, EC, VDCR, landowners
gas	Marcellus shale	aquatics	instream flows - alterations, sedimentation, contaminants, habitat loss/ fragmentation	M	coordinate with VDMME and VDEQ on permits and instream monitoring (chemical and biotic); HCPs; collaborative research; acquire subsurface rights in sensitive areas; outreach on environmental impacts of Marcellus Shale drilling and benefits of alternative energy development	EC, CPA, USGS, EPA, VDEQ, VDMME, VDMLR, ES, universities
power generation	dams	all species	instream flows - alterations, habitat alteration/ fragmentation (including migration impacts), sedimentation, thermal impacts	M	work with Cookeville FO and TVA to comment on large dams; comment on FERC regulatory permits; facilitate fish connectivity through population augmentation; outreach on potential environmental impacts of dam operations and benefits of energy conservation and alternative energy development	CPA, EC, ES, FAC, TVA, FERC, VDGIF
wind turbines	wind turbines	migratory birds, bats	habitat alteration/ fragmentation (including migration impacts), direct mortality	M	land protection; HCPs; work with industry; develop BMPs and regulations with state permitting agencies and localities; identify sensitive areas that are of most concern; section 7 when appropriate; explore financial incentives to protect areas of concern; outreach on potential environmental impacts of wind turbines and benefits of energy conservation and alternative energy development	ES, localities, CPA, industry, VDEQ, VDGIF, NGOs, USFS, NPS, VSCC, FERC
mill ponds	small dams	aquatics	instream flows - alterations, habitat alteration/ fragmentation (including migration impacts), sedimentation, thermal impacts	M	work with dam owners on removal and modification; facilitate fish connectivity through population augmentation; outreach on benefits of fish passage and impacts of small dams	PFW, USDA, ES, SWCD, NRDAR, VDOT, FAC, landowners, VDGIF, localities, NGOs
recreation	introduction of non-natives/ disease/pet trade	all species	competition, habitat loss/displacement, reduced viability	M	surveillance for introduced species and develop response plan; encourage outreach; work with pet trade and state agencies on regulations; outreach to boat and pet owners and anglers about problems and how to avoid them	VDGIF, ES, industry, VDCR, anglers, USFS

forestry	deforestation/ forest type conversion, run-off	all species	Instream flows - alterations, habitat loss/degradation/ fragmentation, invasive species, sedimentation	M	land protection; HCPs; work with industry; develop BMPs and regulations with state permitting agencies and localities; identify sensitive areas that are of most concern; section 7 when appropriate; explore financial incentives to protect areas of concern; promote forest management planning; GAP analysis to id riparian restoration needs; outreach to landowners on BMPs	CPA, ES, VDOF, USFS, localities, landowners, industry, NGOs, Migratory Birds, PFW, EC
forestry	pesticide application (including Bt for gypsy moths)	all species	contaminants, habitat degradation, mortality of non-target organisms	M	work with agencies on long-term management plans and non-programmatic projects; work with EPA on label requirements; outreach on pesticide BMPs	ES, EC, CPA, USDA, VDACS, EPA, VDOF
urbanization and commercial/ industrial development	construction/ land disturbance	all species	habitat loss/ degradation/ fragmentation, sedimentation, contaminants, instream flow alteration, degradation of karst systems	M	support erosion and sediment regulations; develop enhanced erosion and sediment control for listed species; monitoring to assess contaminant levels; work with localities on planning and zoning; outreach to communities and landowners on BMPs	ES, PDCs, IDA, USDA, RC&Ds, SWCD, HUD, NGOs, CPA, EC, VDOF, USFS, VDEQ, VDGIF, universities, USGS, localities, landowners
urbanization and commercial/ industrial development	straight pipes	aquatics	nutrient loading, contaminants, sedimentation	M	monitoring to assess contaminant levels; work with localities on planning; research VDOH records to determine where straight pipes are a concern; encourage installation of proper sewage treatment and/or relocation of homes; facilitate funding to correct straight pipes in key areas; outreach to localities on impacts and BMPs	landowners, ES, PDCs, USDA, RC&Ds, SWCD, CDBG, CPA, EC, NGOs, VDEQ, VDGIF, universities, USGS, localities, VDMME, VDOH, Corps, EPA
urbanization and commercial/ industrial development	landfill leachate/ roadside dumps/ littering/waste transfer stations	aquatics	contaminants	M	monitoring to assess threats and contaminants level; identify location of current and historic landfills/ waste dumps; develop appropriate regulations and work with localities to implement regulations; work with localities on siting of facilities; cleanup old dump facilities; encourage door-to-door pickup and waste disposal; outreach to localities on impacts and BMPs	CPA, ES, USGS, VDEQ, localities, RC&Ds, EC, PDCs, EPA, VDCR
urbanization and commercial/ industrial development	water supply (wells, surface water withdrawal, inter intra basin transfer)	aquatics	instream flows - alterations	M	comment on VDEQ/Corps regulatory permits; work with VDEQ to lower the reporting threshold for water withdrawals; review county water supply plans provided to VDEQ; work with RC&Ds and PDCs on water supply planning; develop instream flow models for trust resources; develop water conservation plans; oppose inter intra basin transfer in sensitive areas; review USDA/FSA/HUD loans for water development and promote water conservation; outreach to localities on growth impacts and water conservation	USGS, NGOs, VMRC, TVA, PFW, USDA, EPA, VDEQ, Corps, RC&D, PDC, USDA, localities
agriculture	water withdrawal	aquatics	instream flows - alterations	L	work with VDEQ to lower the water withdrawal reporting threshold; outreach on water conservation to farmers and alternative watering supplies	All, FAC, VDEQ, NGOs, USGS, landowners
agriculture	failure/seepage/	aquatics	nutrient loading,	L	assist with enforcement and cost share to remedy; outreach on	PFW, EC, ES, OLE, VDEQ, VDCR,

	overflow of animal waste storage facilities		biological oxygen demand, eutrophication, chemical contamination		contaminant impacts and prevention to farmers	USDA, EC, PFW, ES, USDA, EPA, VDGIF, SWCD, VDEQ, landowners
agriculture	ditches/tile drains	aquatics	instream flows - alterations	L	restore hydrology; review Corps permits and Swampbuster; outreach to farmers on wetlands benefits and cost share programs	ES, PFW, Corps, USDA, SWCD, VDEQ, RC&D, NGOs, landowners
agriculture	spring development	aquatics	instream flows - alterations	L	request NRCS to report all spring development annually to VDEQ/ Corps; outreach on alternative water supplies and BMPs to farmers	PFW, VDEQ, Corps, NRCS, landowners
aquaculture	hatchery development/ maintenance	aquatics	excessive nutrients, introduction of exotic species, pathogen spread	L	assess future threat and monitor existing threat; outreach on BMPs to private hatcheries	EC, VDEQ, ES, VDGIF; hatchery operators
hard rock mining	point and non-point runoff	aquatics	contaminants, sedimentation	L	work with VDEQ and VDCR and VDMME and Corps, and VMRC on permitting; work with landowners; encourage enhanced E&S controls; protect sensitive areas	ES, EC, CPA, VDMME, Corps, VDCR, VMRC, NGOs, VDEQ, landowners
hard rock mining	heavy equipment	aquatics	direct mortality, habitat degradation	L	work with VDEQ and VDCR and VDMME and Corps, and VMRC on permitting; work with landowners; protect sensitive areas	ES, EC, CPA, VDMME, Corps, VDCR, VMRC, NGOs, VDEQ, landowners
recreation	ORUV	all species	direct destruction of habitat, noise disturbance	L	outreach; work with landowners; fence trails; work with ORUV manufacturers about habitat destruction; establish ORUV trails; outreach about ORUV impacts by use of signs and brochures	PFW, OLE, VDACS, localities, industry, ES, VDGIF LE, USFS, VDOF, VDCR, landowners
forestry	prescribed burning	all species	habitat alteration, smoke, contaminants, run-off, direct mortality	L	promote forest management planning that considers trust resources; BMPs; consult on listed species; facilitate prescribed burning to improve habitat; outreach to landowners on BMPs	CPA, PFW, ES, USFS, VDOF, USDA, VDCR, VDGIF, NGOs, TVA, landowners
urbanization and commercial/ industrial development	flood control	aquatics	instream flow alteration, habitat loss/degradation/ fragmentation	L	review permit applications; report and encourage action on violations; habitat restoration; outreach to landowners and localities on growth impacts and stormwater management	ES, localities, Corps, VMRC, TVA, landowners, CPA, PDCs

[1]See "Service Trust Resources" section.

[2]Includes impact occurring now and likelihood of threat in near-term future. Regarding climate change we are uncertain of the appropriate assessment of threat in some instances and additional data may change a specific assessment of threat over time. Rows with high level threats are highlighted.

[3]Significant outreach and inreach efforts are inherent in many activities and species actions are noted.

[4]"All" refers to all programs in Ecological Services.

JAMES SPINYMUSSEL PRIORITY AREA THREATS ASSESSMENT					
Threat	**Stressor**	**Cause**	**Assessment of Threat on JSM[1] (high medium, low)**	**What Ecological Services Can Do[2]**	**Who Can Address Problem**
habitat loss/ degradation/ fragmentation	sedimentation, temperature, downstream scour	large dams/reservoirs (operation and maintenance of existing dams, construction of new dams)	H	comment/consult on new projects and relicensing and operations; work with localities on watershed/water supply and comprehensive planning; regional HCPs; conservation agreements; public outreach	ES, PFW, Coastal Program, NGOs, VDCR-DNH, localities, FERC, landowners, Corps, CPA, FAC, NRCS, VDGIF, VDEQ
habitat loss/ degradation/ fragmentation	sedimentation/ suspended solids	poor land practices (e.g., small dams, residential and industrial development, forestry, agriculture) and transportation/utilities	H	riparian and stream restoration; work with localities on comprehensive planning; work with state agencies on relevant regulatory changes; regional HCPs; conservation agreements; comment/consultation on projects; public outreach	EC, VDEQ, ES, localities, CPA, NRCS, SWCDs, Coastal Program, PFW, VDGIF, VDCR, Corps, VDOT, VDOF, USFS, landowners
habitat loss/ degradation/ fragmentation	contaminants	spills	H	spill prevention/planning; respond to spills as needed, follow through with NRDAR where appropriate; work with others on training for spill response; identify sensitive areas; work with NRCS and SWCDs on potential threats; assist in threat removal/ reduction; comment on NRCS standard practices	EC, VDEQ, ES, EPA, NRCS, SWCDs, PFW, VDGIF, CPA, localities, VDOT
habitat loss/ degradation/ fragmentation	hydrologic alteration	climate change	H	restore habitat/protect lands; establish/protect habitat corridors; prioritize conservation actions/funding decisions to consider climate change; planning; education/public outreach; work with localities to support low impact development; work with VDEQ on water supply planning to include trust resource needs	ES, NGOs, VDEQ, Coastal Program, PFW, VDGIF. NRCS, SWCDs, Corps, CPA, localities, landowners
demographic constraints	genetics, isolated populations, small population size, etc.	movement barriers for fish host and mussel (e.g., dams, cold water releases, lentic habitat, culverts, low water crossings, embeddedness)	H	remove/modify barriers; provide fish passage; evaluate translocation/augmentation/reintroduction; restore riparian habitat; coordinate with FERC on relicensing and downstream management; permit reviews; regional HCPs	ES, PFW, CPA, FERC, VDGIF, Corps, VDEQ, FAC, NRCS, universities, VDOT, landowners
demographic constraints	genetics, isolated populations, small population size, etc.	spills	H	spill prevention/planning; respond to spills as needed, follow through with NRDAR where appropriate; work with others on training for spill response; identify potential threats; work with NRCS and SWCDs on potential threats; assist in threat removal/ reduction; comment on NRCS standard practices; evaluate translocation/augmentation/reintroduction; public outreach	EC, VDEQ, ES, EPA, NRCS, SWCDs, PFW, VDGIF, CPA, localities, VDOT, courts
demographic constraints	genetics, isolated populations,	Allee effect	H	evaluate this threat; conduct PVA; improve our understanding of demographics; further develop augmentation/reintroduction approach; assess genetic diversity in remaining populations to	ES, universities, USGS, VDGIF, FAC, surveyors

	small population size, etc.			facilitate recovery	
non-native/ problematic native species	shifts in species composition	climate change	H	restore habitat/protect lands; establish/protect habitat corridors; prioritize conservation actions/funding decisions to consider climate change; control invasive; evaluate stressor	PFW, Coastal Program, NRCS, VDGIF, ES, LCCs, NGOs, FAC, landowners
habitat loss/ degradation/ fragmentation	contaminants	nutrients (e.g., straight pipes, all sources)	M	investigate significance of this threat; work with state agencies to fund appropriate wastewater disposal; work with RC&Ds; comment on permits and NRCS standard practices; work with state permitting agencies; restore riparian corridors and conduct public outreach	EPA, VDEQ, ES, EC, VDGIF, PFW, NRCS, RC&Ds, SWCDs, NGOs, Corps
habitat loss/ degradation/ fragmentation	movement/ migration barriers to host fish	dams, pipelines, large sections of unsuitable habitat, culverts, low water crossings	M	provide passage/remove dams; restore habitat; remove/replace culverts; comment on permits; remove/re-route/bury pipelines; identify which impediments are problematic; conduct public outreach as appropriate	PFW, ES, NGOs, VDEQ, Coastal Program, FAC, VDGIF, NRCS, SWCDs, Corps, CPA, landowners
habitat loss/ degradation/ fragmentation	hydrologic alteration	increased runoff, changes in hydroperiod, surface and groundwater withdrawal, increased impervious surfaces	M	work with localities on comprehensive/watershed planning; work with agencies on permits, stormwater regulations, and BMP implementation/design	ES, NGOs, VDEQ, Coastal Program, FERC, FAC, NOAA, VDGIF, NRCS, SWCDs, Corps, CPA, localities
demographic constraints	genetics, isolated populations, small population size, etc.	sedimentation	M	riparian and stream restoration; comment on projects; work with localities on comprehensive planning; work with state agencies on relevant regulatory changes; regional HCPs; conservation agreements; investigate where populations are isolated due to sedimentation; evaluate translocation/augmentation/ reintroduction; determine effects of sedimentation on survival and recruitment of young; conduct public outreach	EC, VDEQ, ES, localities, CPA, NRCS, SWCDs, Coastal Program, PFW, VDGIF, VDCR, EPA, VDOF, USGS, universities, FAC, USFS, landowners
habitat loss/ degradation/ fragmentation	contaminants	pesticides	L	investigate significance of this threat; comment on permits and NRCS standard practices; work with state permitting agencies; riparian restoration; comment on pesticide registration; public outreach	VDACS, VDOT, EPA, VDEQ, ES, EC, VDGIF, PFW, NRCS, USGS
habitat loss/ degradation/ fragmentation	hydrologic alteration	temperature regime alteration (e.g., dams, buffers)	L	investigate significance of this threat; restore riparian buffers; work with localities to support low impact development; evaluate dam operation and maintenance and comment as needed; evaluate discharges	ES, NGOs, VDEQ, Coastal Program, FERC, FAC, NOAA, VDGIF, NRCS, SWCDs, Corps, CPA, localities, landowners
habitat loss/ degradation/ fragmentation	hydrologic alteration	channelization	L	permit review; restore instream and floodplain habitat; Corps planning; work with localities on watershed and comprehensive planning; work with FEMA; land protection; NRCS EWP coordination; public outreach/education	ES, NGOs, VDEQ, Coastal Program, FEMA, PFW, VDGIF, NRCS, SWCDs, Corps, CPA, localities
intentionally left blank	direct mortality from crushing	vehicle crossings, livestock	L	work with VDOT and SWCD on public outreach to landowners; habitat restoration/protection; encourage/design correct stream crossings in sensitive areas	VDOT, SWCD, ES, PFW, NRCS, VDGIF
non-native/ problematic native species	predation/ competition	accidental and intentional introduction of non-native species (e.g., non-native trout,	L	assess trout threat on host fish; work with VDGIF to evaluate stocking program; public outreach to anglers	VDGIF, FAC, ES

		bait buckets)			
non-native/ problematic native species	disease	disease introduction or other stressor (e.g., climate change, contaminants) that increases susceptibility	L	investigate/monitor; reduce other stressors where possible	universities, USGS, FAC, Fish Health Center, VDGIF, EC, ES
[1]Includes impact occurring now and likelihood of threat in near-term future. Regarding climate change we are uncertain of the appropriate assessment of threat in some instances and additional data may change a specific assessment of threat over time. Rows with high level threats are highlighted.					
[2]Significant outreach and inreach efforts are inherent in may activities and specific actions are noted.					

MADISON CAVE ISOPOD PRIORITY AREA THREATS ASSESSMENT					
Threat	**Stressor**	**Cause**	**Assessment of Threat on MCI[1] (high, medium, low)**	**What Ecological Services Can Do[2]**	**Who Can Address Problem**
habitat loss/ degradation/ fragmentation	hydrologic alterations	fill (sinkholes, fissures etc.)	H	outreach to landowners, stress that it is a water quality issue; clean out sinkholes	landowners, VDOT, NRCS, ES, PFW, CPA, VDCR-DNH, localities, NGOs,
habitat loss/ degradation/ fragmentation	hydrologic alterations	impervious surface and runoff	H	stormwater management; outreach to promote low impact site development (i.e., pervious surfaces, rain gardens); habitat restoration/protection; identify recharge areas of known occurrences, outreach to landowners, stress importance of recharging local aquifers	NPS, localities, PFW, VDCR, NRCS, VDOF, ES, NGOs
habitat loss/ degradation/ fragmentation	hydrologic alterations	water withdrawal/inter intra basin transfer (conversion of ground water to surface water)	H	investigate the severity of this threat; work with VDEQ on permits, regulations, and policies; water supply planning	VDEQ, ES, universities, VDCR, USGS, localities, CPA, NGOs
habitat loss/ degradation/ fragmentation	hydrologic alterations	climate change	H	assess and monitor effects of climate change; habitat restoration/ protection	NGOs, ES, PFW, CPA, VDCR, LCCs, USGS, localities, landowners
habitat loss/ degradation/ fragmentation	nutrient loading	agricultural fertilizer/ biosolids application	H	permit reviews, work with VDEQ on regulations; work with NRCS/ VDCR on standards and specs; restore/protect habitat buffers; work with NRCS and SWCD to implement BMPs	EC, NGOs, PFW, NRCS, SWCD, VDEQ, VDCR, landowners, localities, ES
habitat loss/ degradation/ fragmentation	contaminants	Spills	H	spill prevention/planning, respond to spills as needed, follow through with NRDAR where appropriate; work with others on training for spill response	EC, CPA, ES, VDEQ, EPA,
habitat loss/ degradation/ fragmentation	contaminants	Biosolids	H	permit reviews, work with VDEQ on regulations; restore/protect habitat buffers; work with NRCS and SWCD to implement BMPs	EC, NGOs, PFW, NRCS, SWCD, VDEQ, VDCR, landowners, localities, ES
habitat loss/ degradation/ fragmentation	contaminants	non-point source (e.g., roads, pesticides)	H	develop application BMPs; buffer restoration and protection work with VDACS; section 7 consultation; work with VDOT, localities, and NRCS on BMPs to avoid sensitive areas; identify most significant threats; develop a list of approved pesticides	industry, PFW, SWCD, VDACS, VDOT, ES, NRCS, localities, EC, VDCR, USGS, NGOs, landowners
demographic constraints	genetics, isolated populations, small population size, etc.	loss of connectivity and genetic diversity (e.g., hydrologic alteration, habitat degradation/loss, spills)	H	work with USGS-Leetown Science Center and other researchers to further knowledge of the genetics of each population; assess the threat level of this stressor; land protection; encourage local zoning; permit review; review county water supply plans; work with counties to leave corridors intact	ES, USGS, universities, VDCR, NGOs
lack of info on	intentionally	intentionally left blank	H	determine connectivity of aquifers and identify recharge zones;	ES, NGOs, USGS, universities, VDCR

species	left blank			determine range and conduct rangewide survey; genetic information; life history information	
habitat loss/ degradation/ fragmentation	hydrologic alterations	alteration of drainage pattern/recharge (e.g., diversions, impoundments)	M	hydrologic restoration/protection; culvert sizing; stormwater management guidelines; low impact development; identify recharge areas of known occurrences	ES, VDOT, Corps, VDCR, localities, NGOs
habitat loss/ degradation/ fragmentation	hydrologic alterations	collapsing or shifting of karst limestone from blasting, trenching, digging, mining, etc.	M	permit review; develop BMPs; HCPs	ES, CPA, VDCR, universities, USGS
habitat loss/ degradation/ fragmentation	nutrient loading	aging septic systems/straight pipes, livestock, animal waste storage facilities	M	work on regulations with VDEQ; comment on discharge permits; review and implement USDA BMP specifications; restore/protect habitat buffers; determine effects of nutrients and threat level	VDEQ, VDCR, USGS, PFW, NRCS, SWCD, EC
habitat loss/ degradation/ fragmentation	sedimentation	runoff from residential/ commercial development, agriculture, transportation, utilities, poor land management	M	assess threat level of this stressor; restore habitat/protect lands; work with landowners(outreach), localities, VDOT, etc. on developing and implementing BMPs; section 7	PFW, EC, VDEQ, ES, VDCR, VDOT, NGOs, localities, NRCS, industry
habitat loss/ degradation/ fragmentation	contaminants	mercury - South River	M	DuPont NRDAR	EC
habitat loss/ degradation/ fragmentation	contaminants	point source discharges (municipal or industrial wastewater treatment plants - endocrine disruptors, personal care products, pharmaceuticals, etc.)	M	evaluate the threat; work with EPA on developing regulations; work with VDEQ on discharge permit reviews; section 7; EC	EPA, VDEQ, ES, EC, USGS, universities
demographic constraints	genetics, isolated populations, small population size, etc.	Allee effect/low reproductive viability in existing patchy habitat	M	assess the threat level of this stressor; restore/protect habitat and recharge areas; connectivity/corridors; permit reviews	PFW, ES, EPA, VDEQ, VDCR, USGS, universities, NGOs, NRCS, CPA, landowners
habitat loss/ degradation/ fragmentation	contaminants	water pH chemistry (change in ionic potential from surface runoff to dilute Ca availability)	L	assess the effects	ES, EC, universities, USGS
invasives	intentionally left blank	intentionally left blank	Unknown	work with VDCR to track this issue	ES, VDCR, universities, USGS, EC
disease	intentionally left blank	intentionally left blank	Unknown	work with VDCR to track this issue	ES, VDCR, universities, USGS
[1]Includes impact occurring now and likelihood of threat in near-term future. Regarding climate change we are uncertain of the appropriate assessment of threat in some instances and additional data may change a specific assessment of threat over time. Rows with high level threats are highlighted.					
[2]Significant outreach and inreach efforts are inherent in many activities and specific actions are noted.					

NORTHEASTERN BEACH TIGER BEETLE PRIORITY AREA THREATS ASSESSMENT					
Threat	**Stressor**	**Cause**	**Assessment of Threat on NBTB[1] (high, medium, low)**	**What Ecological Services Can Do[2]**	**Who Can Address Problem**
habitat loss/ degradation/ fragmentation	shoreline modification (changes in sand transport and placement of structure and change in habitat conditions)	bulkhead/riprap	H	permit review to encourage less destructive measures and minimize impacts, look for funding to assist landowners to offset their costs for alternate shoreline protection (living shoreline), public outreach, localities, permitting agencies; buy shoreline habitat, encourage shoreline protection/planning in a regional context, evaluate adjacent impacts	ES, Corps, landowners, VIMS, NOAA, localities, VDCR-DNH, VMRC, contractors, NGOs, Coastal Program, PFW
habitat loss/ degradation/ fragmentation	shoreline modification (changes in sand transport and placement of structure and change in habitat conditions)	groins/jetties	H	permit review to encourage less destructive measures, look for funding to assist landowners to offset their costs for alternate shoreline protection (living shoreline), outreach to public, localities, permitting agencies; buy shoreline habitat, encourage shoreline protection/planning in a regional context, evaluate adjacent impacts	ES, Corps, VIMS, NOAA, localities, VDCR-DNH, VMRC, contractors, NGOs, Coastal Program, PFW, landowners
habitat loss/ degradation/ fragmentation	shoreline modification (changes in sand transport and placement of structure and change in habitat conditions)	construction/upland disturbance	H	comment on projects, work with localities on comprehensive planning; regional HCPs; conservation agreements; public outreach	ES, PFW, Coastal Program, NGOs, VDCR-DNH, localities
habitat loss/ degradation/ fragmentation	contaminants	spills (off shore)	H	spill prevention/planning, respond to spills as needed, work with others on training for spill response; follow through with NRDAR where appropriate	EC, NWRS, USCG, VDEQ, ES
habitat loss/ degradation/ fragmentation	climate change	shifts in native communities/species composition, including non-natives	H	restore habitat/protect lands, establish/protect habitat corridors, prioritize conservation actions/funding decisions to consider climate change, control invasives	PFW, Coastal Program, NOAA, ES, NGOs, VDCR-DNH, NWRS, landowners
habitat loss/ degradation/ fragmentation	climate change	human migration/ relocation	H	restore habitat/protect lands, education/outreach	PFW, Coastal Program, NOAA, ES, NGOs, VDCR-DNH, NWRS, landowners

habitat loss/ degradation/ fragmentation	climate change	sea level rise	H	restore habitat/protect lands, establish/protect habitat corridors, prioritize conservation actions/funding decisions to consider climate change, planning, education/outreach	PFW, Coastal Program, NOAA, ES, NGOs, VDCR-DNH, NWRS, landowners
habitat loss/ degradation/ fragmentation	climate change	increased storm events (number and severity)	H	restore habitat/protect lands, establish/protect habitat corridors, prioritize conservation actions/funding decisions to consider climate change, planning, education/outreach	PFW, Coastal Program, NOAA, ES, NGOs, VDCR-DNH, NWRS, landowners
demographic constraints	genetics, isolated populations, small populations, etc.	spills	H	spill prevention/planning, respond to spills, work with others on training for spill response; respond and assess effects; follow through with NRDAR where appropriate	EC, ES, USCG, VDEQ, EPA, NWRS, NOAA, localities
demographic constraints	genetics, isolated populations, small populations, etc.	development/shoreline alteration	H	land protection, encourage local zoning, permit review, work with counties on comprehensive shoreline management plans and to promote protection of shoreline habitats	ES, Coastal Program, PFW, localities, NWRS, NGOs, VDCR-DNH, NOAA, landowners
demographic constraints	genetics, isolated populations, small populations, etc.	human activities (e.g., driving, foot traffic)	H	assess threat; implement appropriate control measures; planning; habitat restoration; public outreach; local ordinances to prevent use during appropriate times	ES, Coastal Program, PFW, localities, NWRS, NGOs, researchers, VDCR-DNH, NOAA, landowners
demographic constraints	genetics, isolated populations, small populations, etc.	storm events	H	restore/protect habitat, maintain connectivity of sites, population augmentation; genetic augmentation; genetic research; intensive population management	ES, Coastal Program, PFW, localities, NWRS, NGOs, VDCR-DNH, NOAA, researchers, FEMA, landowners
habitat loss/ degradation/ fragmentation	shoreline modification (changes in sand transport and placement of structure and change in habitat conditions)	breakwaters	M	permit review to minimize impacts, investigate design standards; look for funding to assist landowners to offset their costs for alternate shoreline protection (living shoreline), outreach/ education to public, localities, permitting agencies; buy shoreline habitat, encourage shoreline protection/planning in a regional context, evaluate adjacent impacts	ES, Corps, landowners, VIMS, NOAA, localities, VDCR-DNH, VMRC, contractors, NGOs, Coastal Program, PFW
habitat loss/ degradation/ fragmentation	shoreline modification (changes in sand transport and placement of structure and change in habitat conditions)	beach/dune augmentation (including dredge spoil placement)	M	permit review to minimize impacts, investigate design standards, including grain size analysis; look for funding to assist landowners to offset their costs for integrated shoreline protection, outreach to public, localities, permitting agencies; buy shoreline habitat, encourage shoreline protection/planning in a regional context, evaluate adjacent impacts	ES, Corps, landowners, VIMS, NOAA, localities, VDCR-DNH, VMRC, contractors, NGOs, Coastal Program, PFW

demographic constraints	genetics, isolated populations, small populations, etc.	Allee effect	M	restore/protect habitat, maintain connectivity of sites, permit reviews, population augmentation; genetic augmentation; genetic research; intensive population management	ES, Coastal Program, PFW, localities, NWRS, NGOs, VDCR-DNH, NOAA, researchers, landowners
habitat loss/ degradation/ fragmentation	shoreline modification (changes in sand transport and placement of structure and change in habitat conditions)	dredging for navigation/ dredge material placement offshore	L	review permits; evaluate impacts to determine level of threat	ES, Corps, landowners
habitat loss/ degradation/ fragmentation	shoreline modification (changes in sand transport and placement of structure and change in habitat conditions)	non-native plants	L	assess threat; implement appropriate control measures; planning; habitat restoration; public outreach	ES, Coastal Program, PFW, localities, NWRS, NGOS, researchers, VDCR-DNH, NOAA, landowners
habitat loss/ degradation/ fragmentation	contaminants	pesticides	L	work with counties, public outreach; determine threat level and type of mosquito control; determine threats from commercial lawn applications (e.g., Chemlawn), landowner pesticide applications, etc.	EC, NWRS, VDEQ, ES, localities, VDACS
demographic constraints	genetics, isolated populations, small populations, etc.	competition/predation (native and non-native insect and plant species)	L	assess threat; implement appropriate control measures; planning; habitat restoration; public outreach	ES, USDA-WS, Coastal Program, NOAA, localities, PFW, NWRS, NGOs, VDCR-DNH, researchers, landowners

[1]Includes impact occurring now and likelihood of threat in near-term future. Regarding climate change we are uncertain of the appropriate assessment of threat in some instances and additional data may change a specific assessment of threat over time. Rows with high level threats are highlighted.

[2]Significant outreach and inreach efforts are inherent in may activities and specific actions are noted.

ROANOKE LOGPERCH PRIORITY AREA THREATS ASSESSMENT					
Threat	**Stressor**	**Cause**	**Assessment of Threat on Logperch[1] (high, medium, low)**	**What Ecological Services Can Do[2]**	**Who Can Address Problem**
habitat loss/ degradation/ fragmentation	intentionally left blank	large dams/reservoirs (operation and maintenance of existing dams, construction of new dams)	H	comment on new projects and relicensing and operations; work with localities on watershed/water supply and comprehensive planning; regional HCPs; conservation agreements	ES, PFW, Coastal Program, NGOs, VDCR-DNH, localities, FERC, landowners, Corps, CPA, FAC, NRCS, VDGIF
habitat loss/ degradation/ fragmentation	sedimentation/ suspended solids	poor land practices (e.g., dams, residential and industrial development, forestry, agriculture) and transportation/utilities	H	riparian and stream restoration; comment on projects; work with localities on comprehensive planning; work with state agencies on relevant regulatory changes; regional HCPs; conservation agreements; outreach to private landowners on sediment effects instream	EC, VDEQ, ES, localities, CPA, NRCS, SWCDs, Coastal Program, PFW, VDGIF, landowners
habitat loss/ degradation/ fragmentation	contaminants	spills	H	spill prevention/planning; respond to spills as needed; work with others on training for spill response; identify potential threats; work with NRCS and SWCDs on potential threats; assist in threat removal/ reduction; comment on NRCS standard practices; conduct outreach; follow through with NRDAR where appropriate	EC, VDEQ, ES, EPA, NRCS, SWCDs, PFW, VDGIF, CPA, localities
habitat loss/ degradation/ fragmentation	movement/ migration barriers	dams, pipelines, large sections of unsuitable habitat, culverts, low water crossings	H	provide passage/remove dams; restore habitat; remove/replace culverts; comment on permits; remove/re-route/bury pipelines; identify which impediments are problematic; fund additional studies (e.g., cues to movement); conduct outreach to localities and dam/ utility owners on instream effects	PFW, ES, NGOs, VDEQ, Coastal Program, FAC, NOAA, VDGIF. NRCS, SWCDs, Corps, CPA, landowners
habitat loss/ degradation/ fragmentation	hydrologic alteration	climate change	H	restore habitat/protect lands; establish/protect habitat corridors; prioritize conservation actions/funding decisions to consider climate change; planning; education/outreach; work with localities to support low impact development; work with VDEQ on water supply planning to include trust resource needs	ES, NGOs, VDEQ, Coastal Program, VDGIF, NRCS, SWCDs, Corps, CPA, localities, landowners
demographic constraints	genetics, isolated populations, small population size, etc.	movement barriers (e.g., dams, cold water releases, lentic habitat, culverts, low water crossings, embeddedness)	H	remove/modify barriers; provide fish passage; evaluate translocation/augmentation/reintroduction; restore riparian habitat; coordinate with FERC on relicensing and downstream management; permit reviews; regional HCPs; conduct outreach with VDOT, localities and private landowners	ES, PFW, CPA, FERC, VDGIF, Corps, VDEQ, FAC, NRCS, universities, VDOT, NGOs, landowners
demographic constraints	genetics, isolated populations, small population size, etc.	spills	H	spill prevention/planning; respond to spills as needed; work with others on training for spill response; identify potential threats; work with NRCS and SWCDs on potential threats; assist in threat removal/ reduction; comment on NRCS standard practices; evaluate translocation/augmentation/reintroduction; conduct outreach;	EC, VDEQ, ES, EPA, NRCS, SWCDs, PFW, VDGIF, CPA, localities, VDOT, courts

				follow through with NRDAR where appropriate	
non-native/ problematic native species	shifts in species composition	climate change	H	restore habitat/protect lands; establish/protect habitat corridors; prioritize conservation actions/funding decisions to consider climate change; control invasives	PFW, Coastal Program, NRCS, VDGIF, ES, NOAA, FAC , NGOs, landowners
habitat loss/ degradation/ fragmentation	contaminants	nutrients (e.g., straight pipes)	M	investigate significance of this threat; work with state agencies to fund appropriate wastewater disposal; work with RC&Ds; comment on permits and NRCS standard practices; work with state permitting agencies; restore riparian corridors	EPA, VDEQ, ES, EC, VDGIF, PFW, NRCS, RC&Ds, SWCDs, NGOs, Corps, landowners
habitat loss/ degradation/ fragmentation	contaminants	PCBs	M	investigate significance of this threat	EC, VDEQ, ES, EPA, USGS, localities
habitat loss/ degradation/ fragmentation	hydrologic alteration	increased runoff, changes in hydroperiod, surface and groundwater withdrawal, increased impervious surfaces	M	work with localities on comprehensive/watershed planning; work with agencies on permits, stormwater regulations, and BMP implementation/design	ES, NGOs, VDEQ, Coastal Program, FERC, FAC, NOAA, VDGIF. NRCS, SWCDs, Corps, CPA, localities
habitat loss/ degradation/ fragmentation	hydrologic alteration	channelization	M	permit review; restore instream and floodplain habitat; Corps planning; work with localities on watershed and comprehensive planning; work with FEMA; land protection; NRCS EWP coordination; outreach to private landowners on effects to stream stability and property	ES, NGOs, VDEQ, Coastal Program, FEMA, VDGIF, NGOs, NRCS, SWCDs, Corps, CPA, localities, landowners
demographic constraints	genetics, isolated populations, small population size, etc.	sedimentation	M	riparian and stream restoration; comment on projects; work with localities on comprehensive planning; work with state agencies on relevant regulatory changes; regional HCPs; conservation agreements; investigate where populations are isolated due to sedimentation; evaluate translocation/augmentation/ reintroduction	EC, VDEQ, ES, localities, CPA, NRCS, SWCDs, Coastal Program, PFW, VDGIF, VDCR, EPA, VDOF, USFS, NGOs, landowners
habitat loss/ degradation/ fragmentation	contaminants	pesticides	L	investigate significance of this threat; comment on permits and NRCS standard practices; work with state permitting agencies	VDACS, VDOT, EPA, VDEQ, ES, EC, VDGIF, PFW, NRCS
habitat loss/ degradation/ fragmentation	contaminants	acid deposition	L	investigate significance of this threat	universities, USGS, ES, EPA, VDEQ
habitat loss/ degradation/ fragmentation	hydrologic alteration	temperature regime alteration	L	investigate significance of this threat; restore riparian buffers; work with localities to support low impact development; evaluate dam operation and maintenance and comment as needed; evaluate discharges	ES, NGOs, VDEQ, Coastal Program, FERC, FAC, NOAA, VDGIF. NRCS, SWCDs, Corps, CPA, localities, EC, landowners
non-native/ problematic native species	predation/ competition	accidental and intentional introduction of non-native species (e.g., non-native trout, bait buckets)	L	assess trout threat; work with VDGIF to evaluate stocking program; public outreach to anglers and bait suppliers	VDGIF, FAC, ES
non-native/ problematic	disease	disease introduction or other stressor (e.g.,	L	investigate/monitor; reduce other stressors where possible	universities, USGS, NGOs, FAC, Fish Health Center, VDGIF, ES

native species		climate change, contaminants) that increases susceptibility			
[1]Includes impact occurring now and likelihood of threat in near-term future. Regarding climate change we are uncertain of the appropriate assessment of threat in some instances and additional data may change a specific assessment of threat over time. Rows with high level threats are highlighted.					
[2]Significant outreach and inreach efforts are inherent in many activities and specific actions are noted.					

Appendix 3 – Key to Acronyms

ACUB – Army Compatible Use Buffer
All – all U.S. Fish and Wildlife Service's Ecological Services programs
AML – Abandoned Mine Lands
BCC – U.S. Fish and Wildlife Service Birds of Conservation Concern
BMP – Best Management Practice
BO – Biological opinion
BTAG – Biological Technical Assistance Group
CDBG – U.S. Department of Agriculture Housing and Urban Development Community Development Block Grant
Coastal Program – U.S. Fish and Wildlife Service Coastal Program
Corps – U.S. Army Corps of Engineers
CPA – U.S. Fish and Wildlife Service Conservation Planning Assistance Program
DoD – U.S. Department of Defense
E&S – Erosion and Sedimentation
EC – U.S. Fish and Wildlife Service Environmental Contaminants Program
EPA – U.S. Environmental Protection Agency
ES – U.S. Fish and Wildlife Service Endangered Species Program
ESA – Endangered Species Act
FAA – Federal Aviation Administration
FEMA – Federal Emergency Management Agency
FERC – Federal Energy Regulatory Commission
FHWA – Federal Highway Administration
FAC – U.S. Fish and Wildlife Service Fish and Aquatic Conservation Program
FO – U.S. Fish and Wildlife Service Field Office
FRA – Federal Rail Administration
FSA – U.S. Department of Agriculture Farm Service Agency
FWCA – Fish and Wildlife Coordination Act
HCP – Habitat Conservation Plan
HUC – Hydrologic Unit Code
HUD – U.S. Department of Agriculture Housing and Urban Development
IDA – Industrial Development Authorities
LCC – Landscape Conservation Cooperative
LLP – Longleaf Pine
Localities – counties, municipalities, cities, local governments
Migratory Birds – U.S. Fish and Wildlife Service Migratory Bird Program
NASA – National Aeronautics and Space Administration

NAWCA – North American Wetlands Conservation Act
NBTB – Northeastern beach tiger beetle
NEPA – National Environmental Policy Act
NGOs – Non-Governmental Organizations
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration
NPS – National Park Service
NRCS – U.S. Department of Agriculture Natural Resource Conservation Service
NRCS EWP – Natural Resource Conservation Service Emergency Watershed Protection Program
NRDAR – U.S. Fish and Wildlife Service Natural Resource Damage Assessment and Restoration Program
NWR – U.S. Fish and Wildlife Service National Wildlife Refuge
NWRS – U.S. Fish and Wildlife Service National Wildlife Refuge System
OLE – U.S. Fish and Wildlife Service Office of Law Enforcement
ORUV – Off-road utility vehicle
OSM – U.S. Office of Surface Mining
PDC – Planning District Commission
PFW – U.S. Fish and Wildlife Service Partners for Fish and Wildlife Program
PVA – Population viability analyses
RC&D – Natural Resource Conservation Service Resource Conservation and Development Program
Service – U.S. Fish and Wildlife Service
SHC – Strategic Habitat Conservation
SHA – Safe Harbor Agreement
SSP – U.S. Geological Survey Science Support Partnership
SSPMs – Species-specific protection measures
SVFO – U.S. Fish and Wildlife Service Southwestern Field Office
SWCD – Soil and Water Conservation District
TMDL – total maximum daily load
TNC – The Nature Conservancy
TVA – Tennessee Valley Authority
USCG – U.S. Coast Guard
USDA – U.S. Department of Agriculture
USDA-WS – U.S. Department of Agriculture Wildlife Services
USFS – U.S. Forest Service
USGS – U.S. Geological Survey
VAFO – U.S. Fish and Wildlife Service Virginia Field Office
VDACS – Virginia Department of Agriculture and Consumer Services
VDCR – Virginia Department of Conservation and Recreation

VDEQ – Virginia Department of Environmental Quality
VDGIF – Virginia Department of Game and Inland Fisheries
VDGIF LE – Virginia Department of Game and Inland Fisheries' Office of Law Enforcement
VDMLR – Virginia Department of Mine Land Reclamation
VDMME – Virginia Department of Mines, Minerals and Energy
VDCR-DNH – Virginia Department of Conservation and Recreation, Division of Natural Heritage
VDOF – Virginia Department of Forestry
VDOH – Virginia Department of Health
VDOT – Virginia Department of Transportation
VIMS – Virginia Institute of Marine Science
VMRC – Virginia Marine Resource Commission
VSCC – Virginia State Corporation Commission